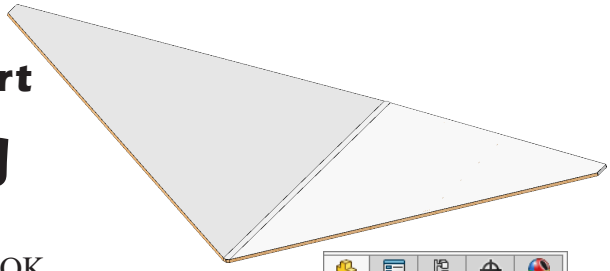
Chapter 5

Delta Dart
Wing



A. Sheet Metal Sketch.

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

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

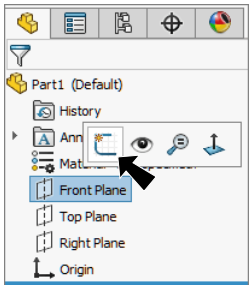


Fig. 1

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

Step 4. Sketch horizontal line from Origin and line up at angle, **Fig. 4**.

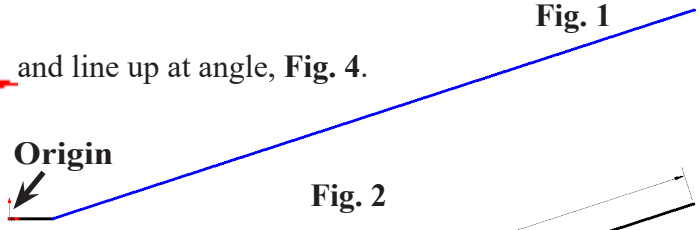


Fig. 2

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

Step 6. Add dimensions, **Fig. 3**. Short horizontal line 1.5 and length of angled line 162.5.

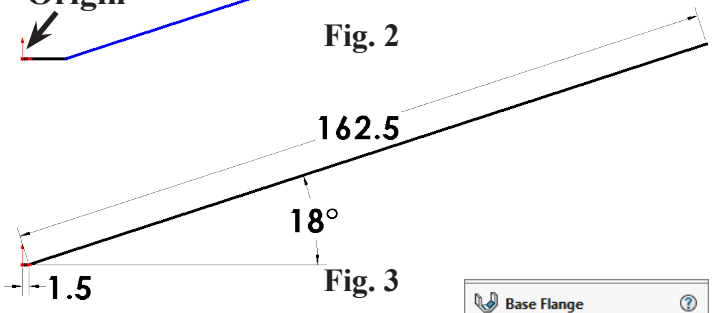


Fig. 3

B. Base Flange.

Step 1. Click **Sheet Metal** on the Command Manager toolbar.

Step 2. Click **Base Flange/Tab** on the Sheet Metal toolbar.

Step 3. In the Base Flange Property Manager set:

under Direction 1, **Fig. 4**

click **Reverse Direction**

Depth D1 **154**

under Sheet Metal Parameters

Sheet Thickness T1 **.05**

Default radius for bends **.01**

click OK .

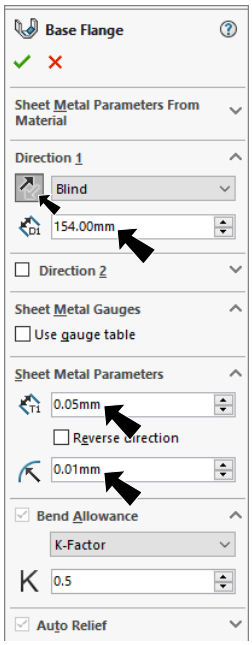


Fig. 4

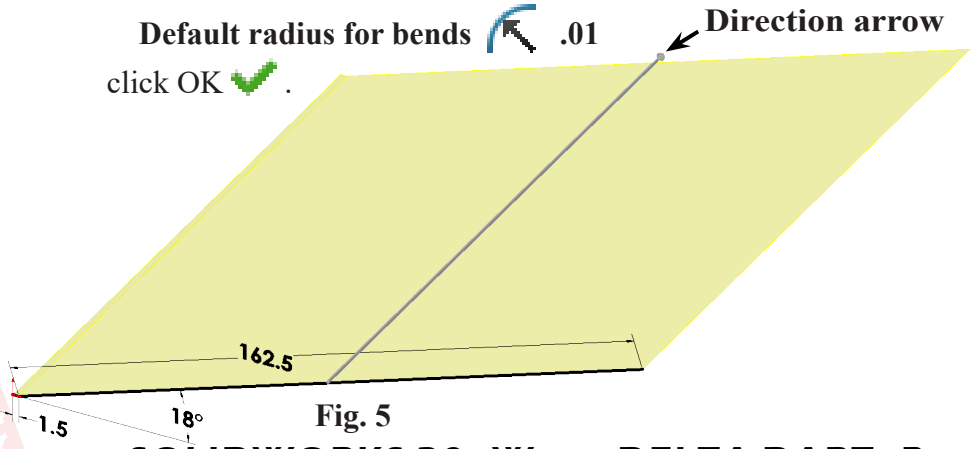


Fig. 5

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C. Save as "WING".

Step 1. Click File Menu > Save As.

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

D. Unfold.

Step 1. Click **Unfold** on the Sheet Metal toolbar.

Step 2. In the Unfold Property Manager set:
under Fixed face, **Fig. 6**
click the **inboard panel**, **Fig. 7**
you might have to zoom
click **Collect All Bends** button
click OK . **Fixed face**

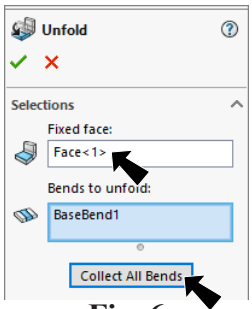

Fig. 6

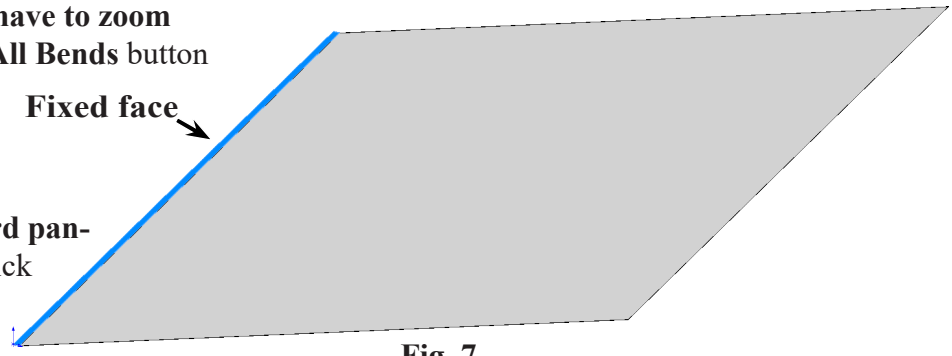
Fig. 7

E. Top Cut.

Step 1. Click the **outboard panel top face** and click **Sketch** on the context toolbar, **Fig. 8**.

Step 2. Click **Line** (**L**) on the Sketch toolbar.

Step 3. Sketch lines from both corner vertices of root edge to Midpoint of tip edge, **Fig. 9**. Use Midpoint relation at midpoint.

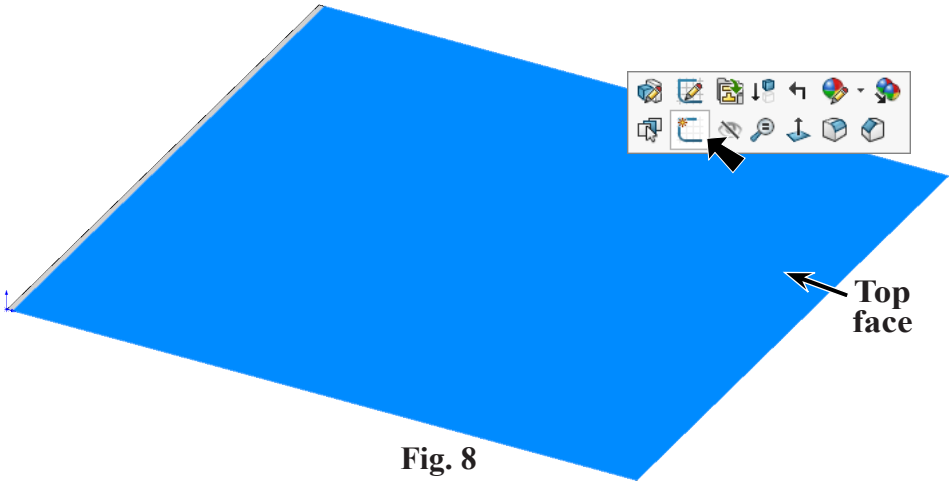

Fig. 8

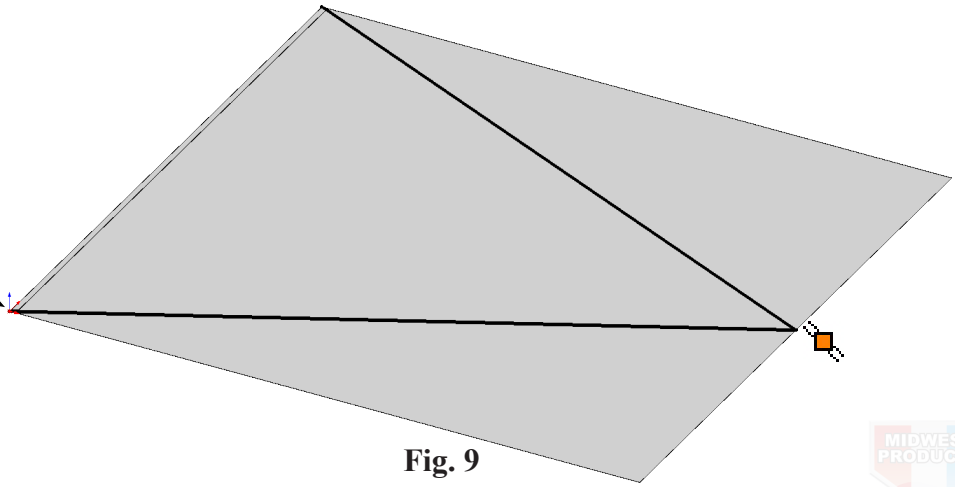

Fig. 9

Step 4. Click **Features** Features on the Command Manager toolbar.

Step 5. Click **Extruded Cut** Extruded Cut on the Features toolbar.

Step 6. In the Cut-Extrude Property Manager set:
under Direction 1, **Fig. 10**
End Condition **Through All**
check **Flip side to cut**
uncheck **Direction 2**
The Direction arrow should point towards area to be cut away, Fig. 11.
If arrow is pointing in wrong direction, uncheck **Flip side to cut, Fig. 10.**
Click OK ✔ .

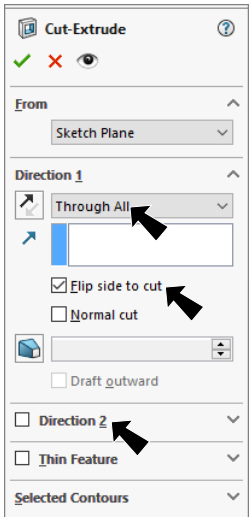

Fig. 10

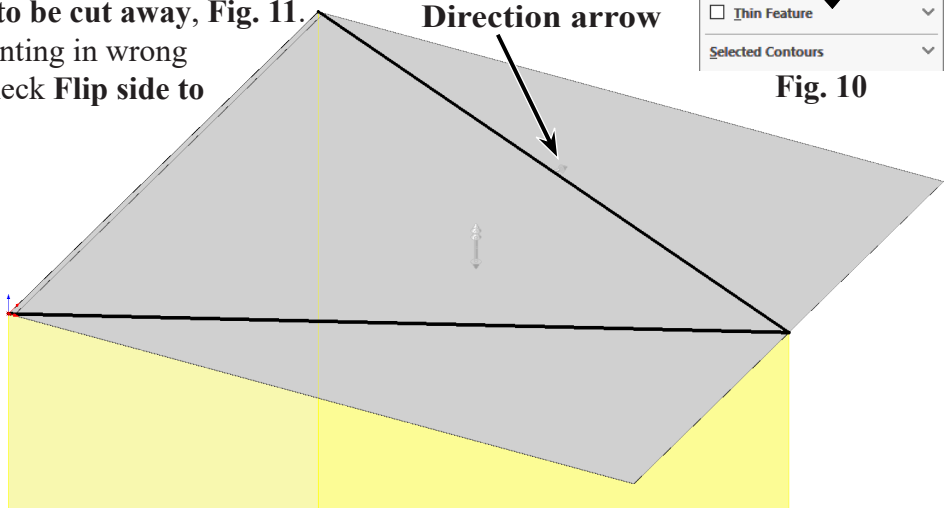

Fig. 11

F. Fold.

Step 1. Click **Sheet Metal** Sheet Metal on the Command Manager toolbar.

Step 2. Click **Fold** Fold on the Sheet Metal toolbar.

Step 3. In the Fold Property Manager set:
click **Collect All Bends** button, **Fig. 12**
click OK ✔ .

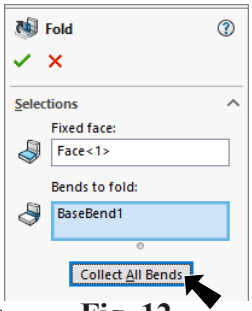

Fig. 12

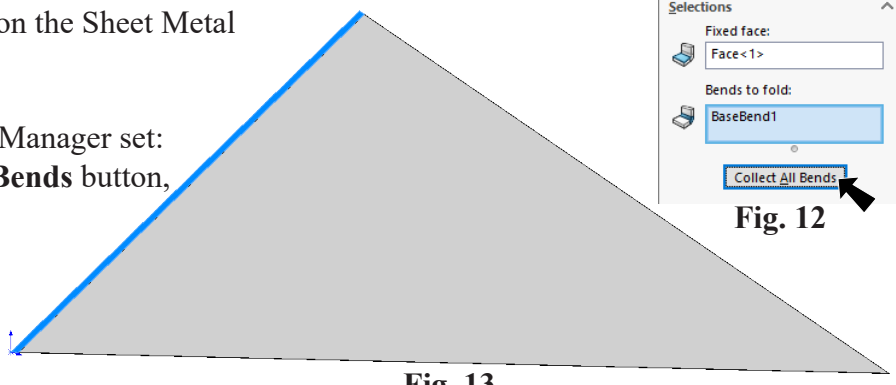
Fig. 13

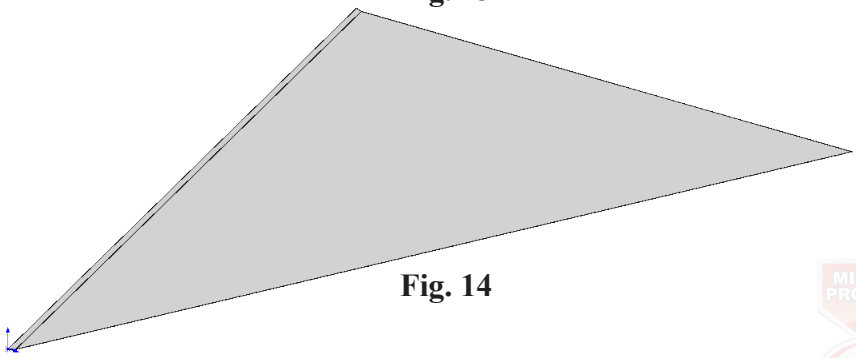
Fig. 14

G. Material Paper -Sheet Metal.

Step 1. Expand **Cut List(1)** in the Feature Manager. Expand **Sheet 1**, **right click Fold1** body and click **Material** > **White Paper** from Favorites list, **Fig. 15**.

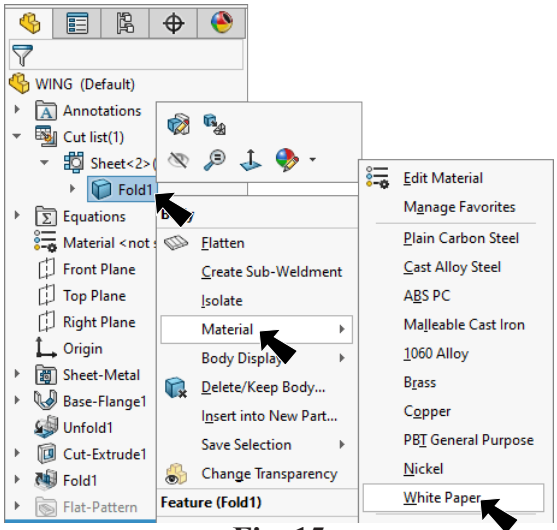

Fig. 15

Step 2. Save. Use **Ctrl-S**.

H. 3D Sketch.

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

Step 2. Click **3D Sketch** 3D Sketch on the Weldments toolbar.

Step 3. Click **Bottom** on the Standard Views toolbar. (**Ctrl-6**)

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

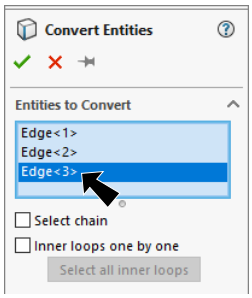

Fig. 16

Step 5. In the Convert Entities Property Manager:
click the **3 edges** of Wing, **Fig. 17**
click OK .

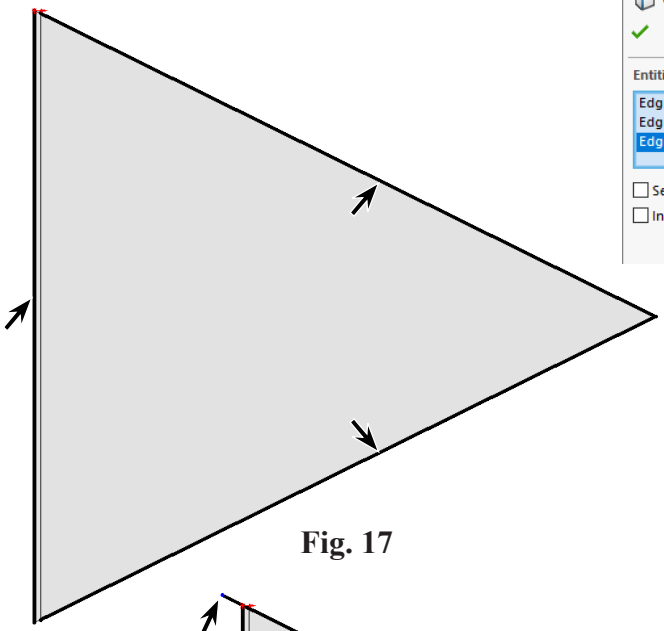

Fig. 17

Step 6. Grab the root endpoint of converted edge and pull endpoint out from Wing, **Fig. 18**. Repeat and pull endpoint out on the other converted edge.

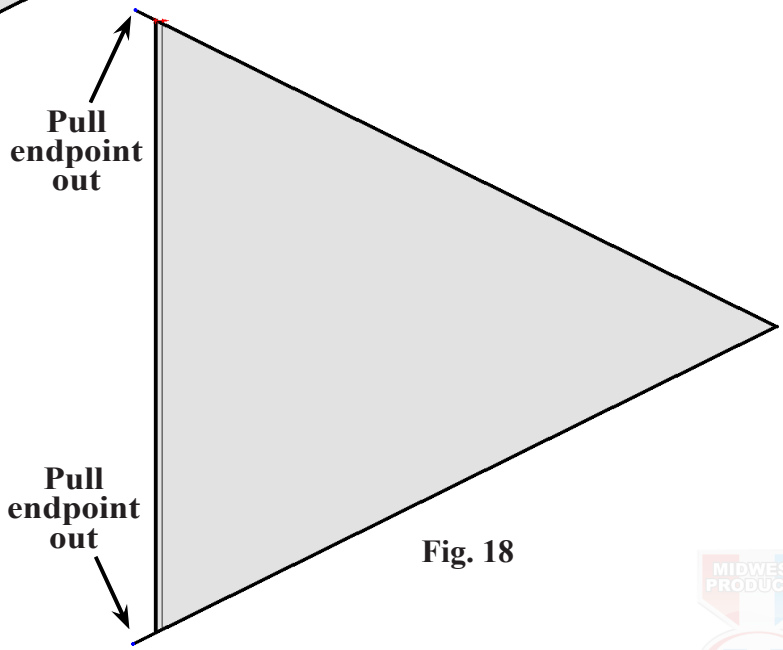

Fig. 18

Step 7. Click **Line** **(L)** on the Sketch toolbar.

Step 8. Sketch vertical line down Wing from leading edge to root edge, **Fig. 19**.

Cursor changes to

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

Step 10. Dimension the converted edge lines **181** and **90 to vertical line**, **Fig. 20**.

Step 11. Click **3D Sketch** on the Sketch toolbar to exit 3D Sketch.

Step 12. Save. Use **Ctrl-S**.

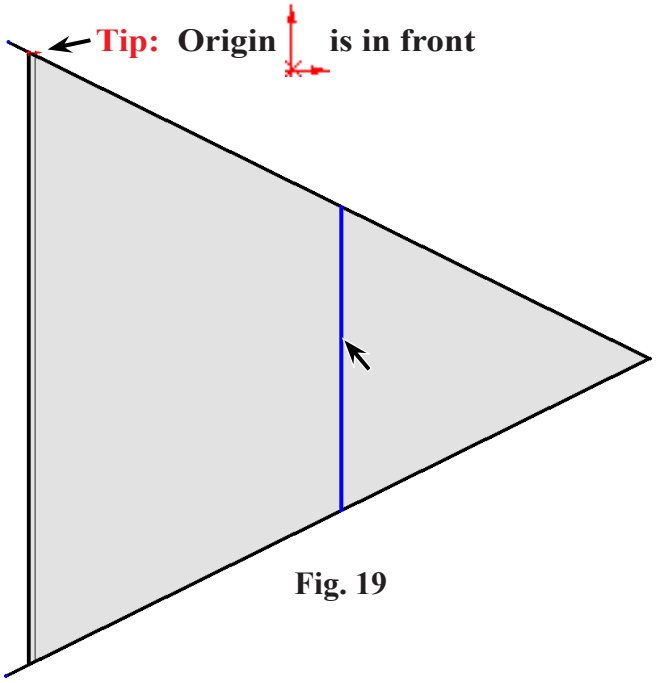

Fig. 19

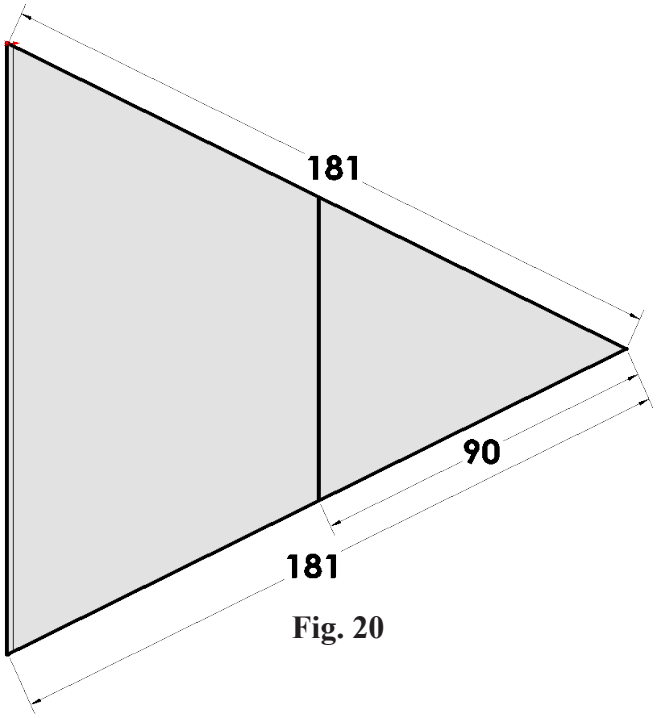

Fig. 20

I. Structural Member.

Step 1. Click **Structural Member**

on the Weldments toolbar.

Step 2. In the Structural Member Property Manager set:

under Standard:

My Profiles, Fig. 21

under Type:

Balsa

under Size:

1.5 x 3

click **line at vertical edge, Line 1 in 3D sketch, Fig. 22**

click **Front** on the Standard Views toolbar. (**Ctrl-1**)

click **Locate Profile** button, **Fig. 21**

click **TOP MIDDLE POINT of profile sketch, Fig. 23. Don't click OK.**

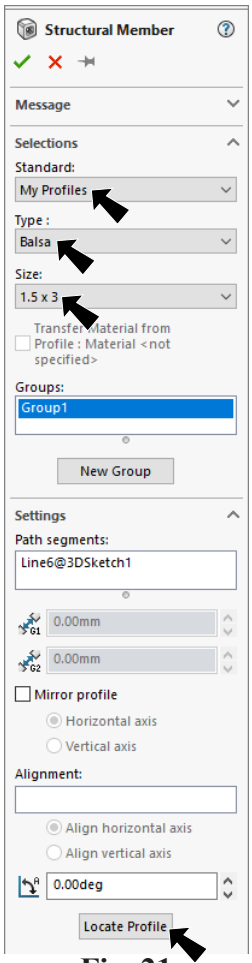

Fig. 21

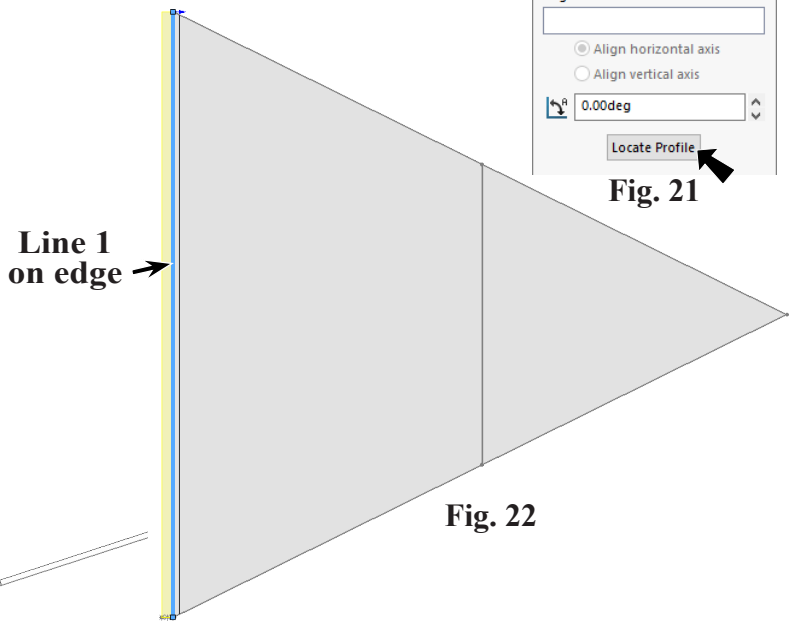

Fig. 22

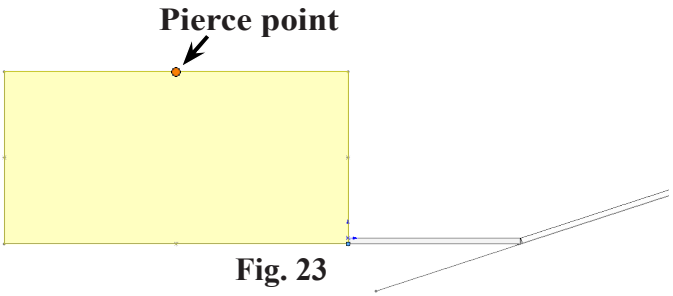

Fig. 23

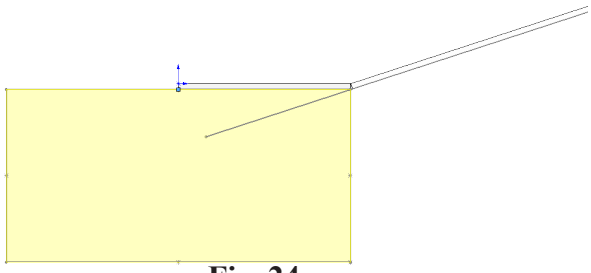

Fig. 24

Step 3. Click **New Group** (2) button, **Fig. 25**

click **Bottom** on the Standard Views toolbar. (**Ctrl-6**)

first click **top converted edge, then bottom converted edge** of **3D sketch**, **Lines 2 and 3**, **Fig. 26**

click **End Miter**

click **Trimetric** on the Standard Views toolbar.

click **Locate Profile** button to zoom in

click in box under Alignment:

click **edge of sheet metal at bend**, **Fig. 27**.

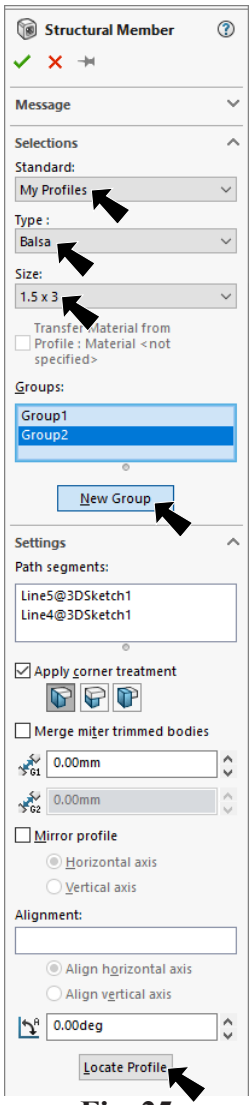

Fig. 25

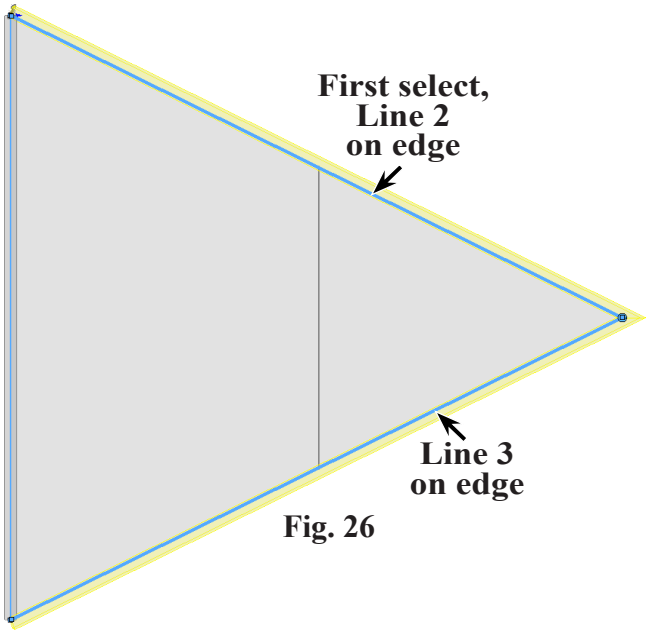

Fig. 26

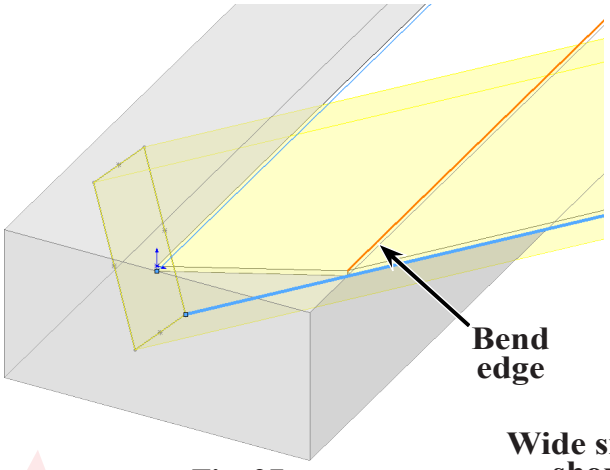

Fig. 27

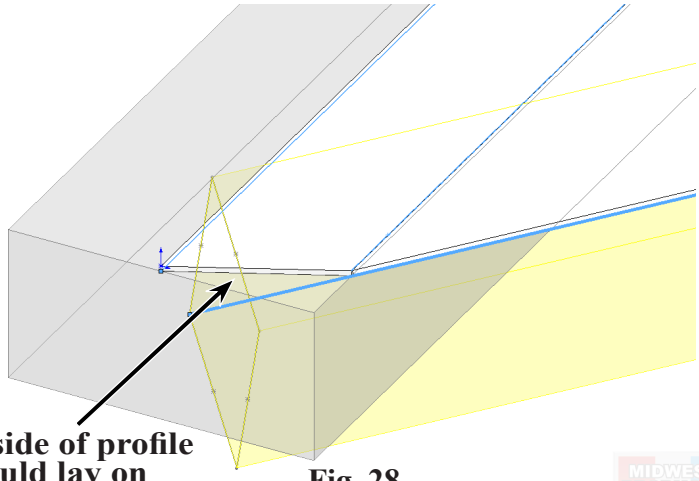

Fig. 28

Step 4. Click **New Group** (3) button, **Fig. 29**

click **Bottom** on the Standard Views toolbar. (**Ctrl-6**)

click **vertical line** of **3D sketch, Line 4**, **Fig. 30**

click **Front** on the Standard Views toolbar. (**Ctrl-1**)

click **Locate Profile** button to zoom in

click in box under Alignment:

click **edge of sheet metal**, **Fig. 31**

click **Locate Profile** button **twice**

click **TOP MIDDLE POINT of profile sketch**, **Fig. 32**
(member should be on bottom of Wing)

click OK ✔ .

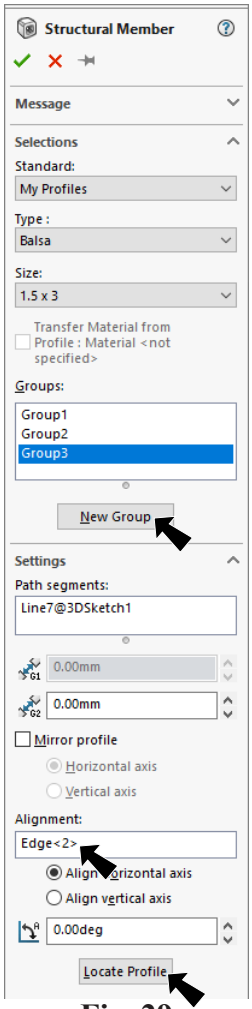

Fig. 29

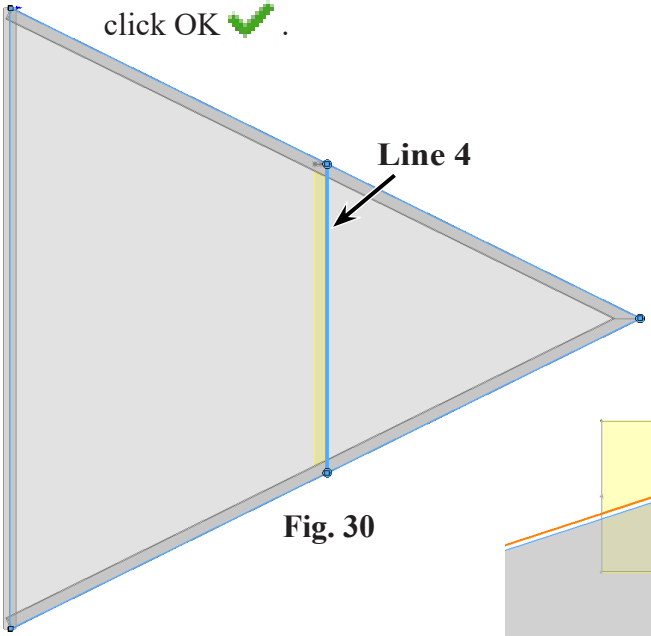

Fig. 30

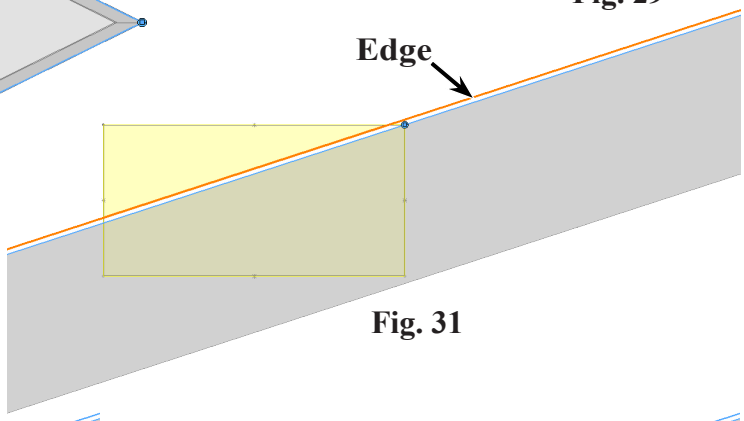

Fig. 31

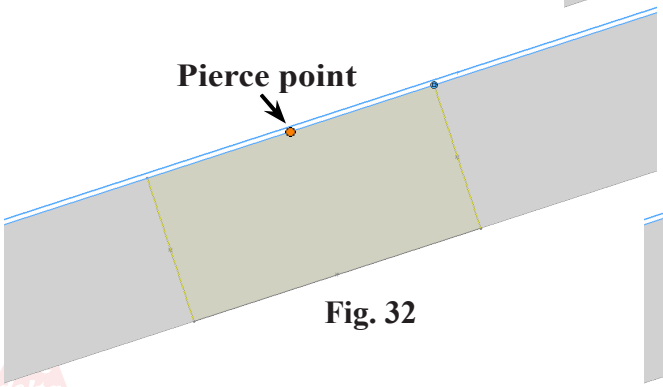

Fig. 32

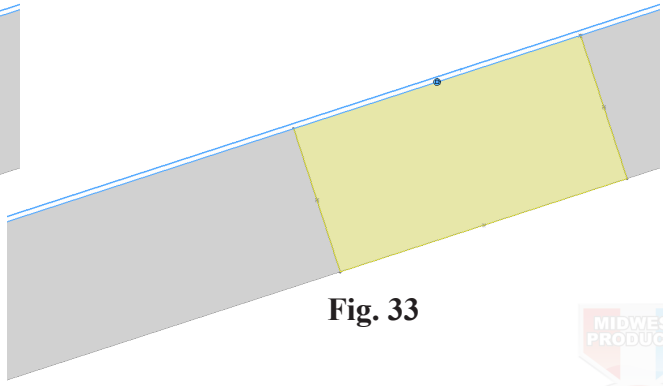

Fig. 33

J. Extruded Cut 2 - Trim Members[3-4].

Step 1. Click **3DSketch1** in the Feature Manager and click **Hide** on the context toolbar, **Fig. 34**.

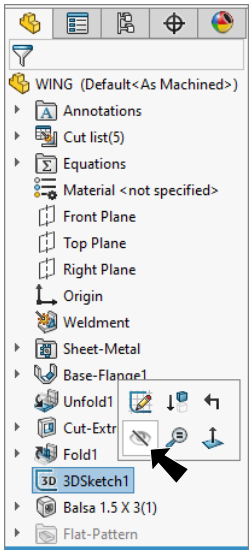

Fig. 34

Step 2. Click **Trimetric** on the Standard Views toolbar.

Step 3. Zoom in around **root edge at leading edge**, **Fig. 35**. To zoom, place the cursor over the root edge of leading edge area and spin the wheel on mouse back. While spinning the wheel keep cursor on the edge.

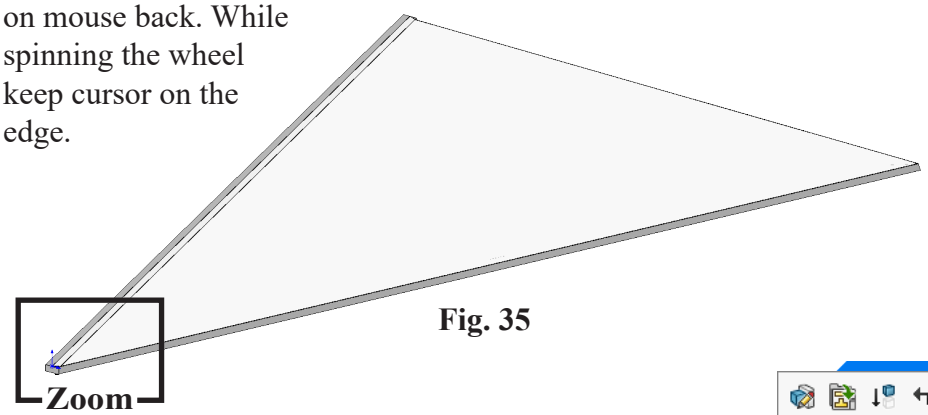

Fig. 35

Step 4. Click **top face of Root Edge Member** and click **Sketch** on the context toolbar, **Fig. 36**.

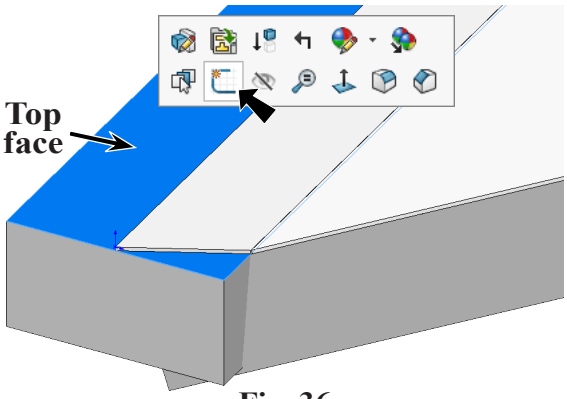

Fig. 36

Step 5. Click off of face to unselect face.

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

Step 7. In the Convert Entities Property Manager:
click **top edge under sheet metal of Root Edge Member**, **Fig. 38**
click OK .

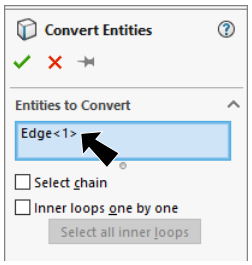

Fig. 37

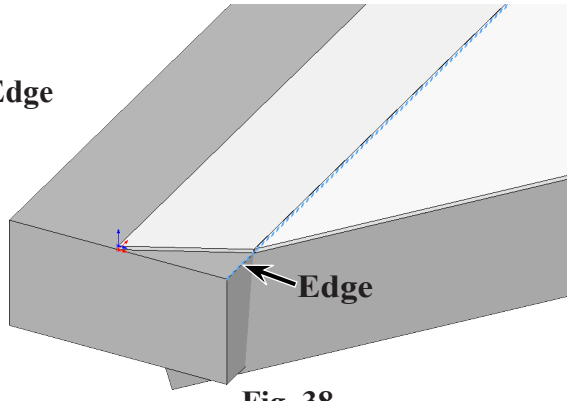

Fig. 38

Step 8. Click **Bottom** on the Standard Views toolbar. (**Ctrl-6**)

Step 9. Click **Features** Features on the Command Manager toolbar.

Step 10. Click **Extruded Cut** Extruded Cut on the Features toolbar.

Step 11. In the Cut-Extrude Property Manager set:

under Direction 1, **Fig. 39**

End Condition **Through All**

uncheck **Flip side to cut**.

Direction arrow should point towards area to be cut away, Fig. 40.

If arrow is pointing in wrong direction, check **Flip side to cut**

uncheck **Directions 2**

under Feature Scope

uncheck **Auto-select**

select **Selected bodies**

click **Leading and Trailing Edge Members, Fig. 40**

click OK .

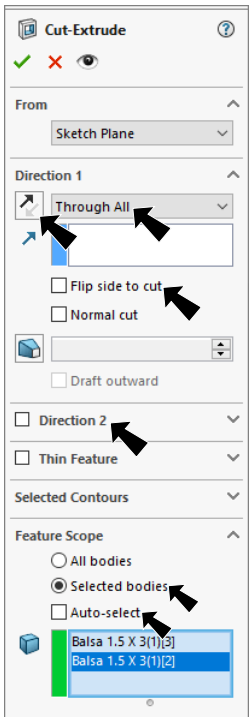

Fig. 39

Tip: Origin is in front

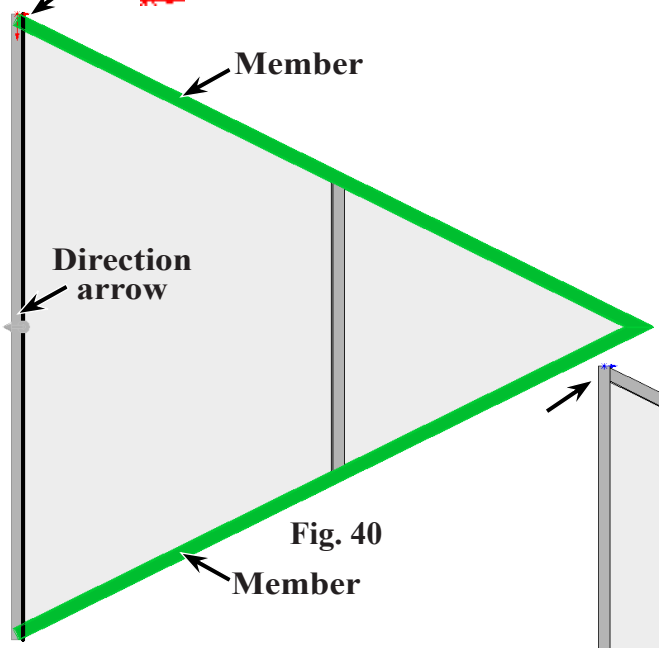

Fig. 40

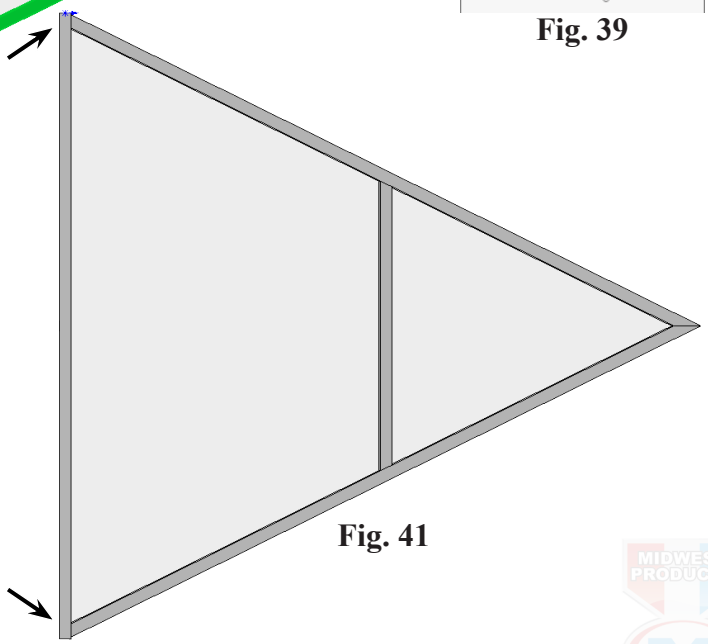

Fig. 41

K. Extruded Cut 3 - Trim Member[1].

Step 1. Use **Previous View** on the Standard Views toolbar. (**Ctrl-Shift-Z**) to return to previous zoomed in view.

Step 2. Click **top face of narrow inboard panel of sheet metal** and click **Sketch** on the context toolbar, **Fig. 42**.

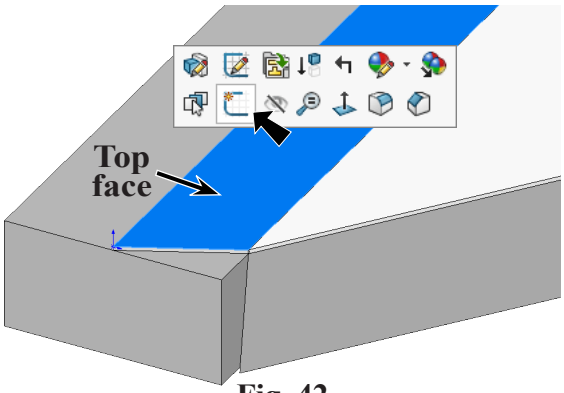

Fig. 42

Step 3. With the face still selected, click **Convert Entities** Convert Entities on the Sketch toolbar, **Fig. 43**.

Step 4. Click **converted root edge of sketch** and click **Construction Geometry** on the context toolbar, **Fig. 44**.

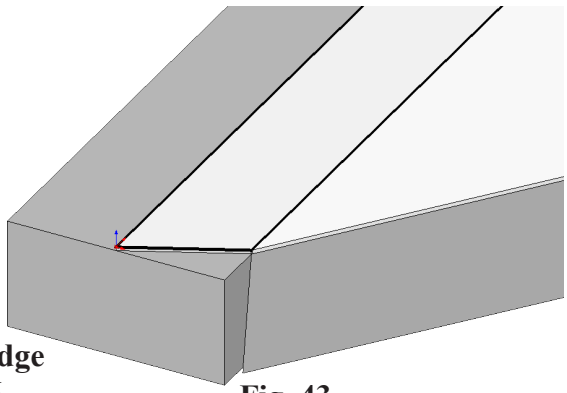
Fig. 43

Step 5. **Right click any other geometry of the sketch** and click **Select Chain** from the menu, **Fig. 45**.

Step 6. Hold down **Ctrl key and click the converted edge construction line** to select all geometry, **Fig. 46**.

Step 7. Click **Mirror Entities** Mirror Entities on the Sketch toolbar, **Fig. 47**.

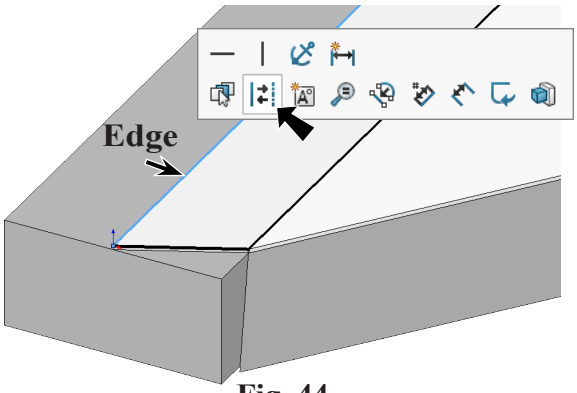

Fig. 44

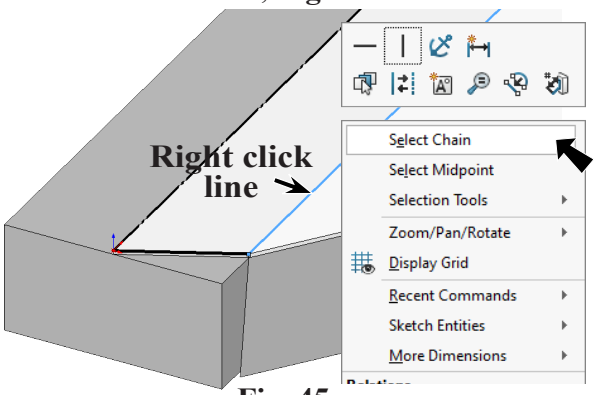

Fig. 45

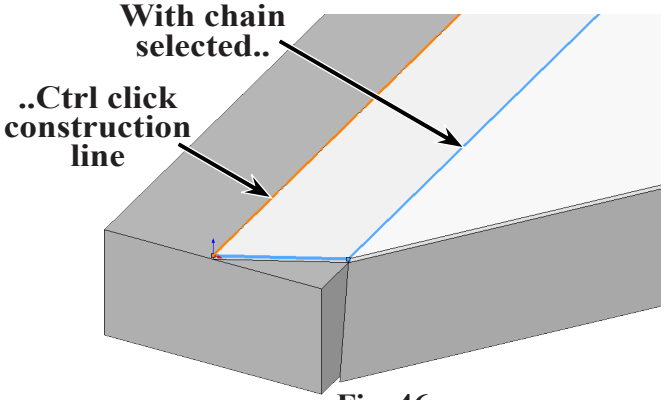

Fig. 46

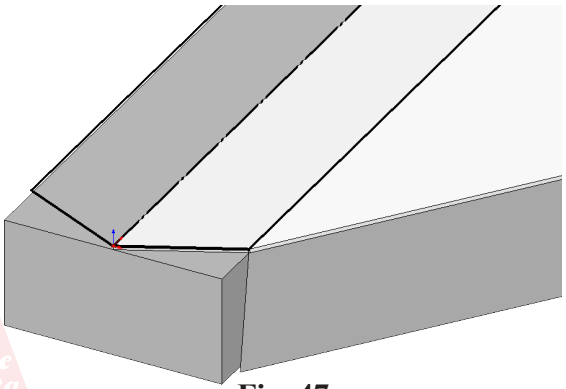
Fig. 47

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

Step 9. Click **Extruded Cut** Extruded Cut on the Features toolbar.

Step 10. In the Cut-Extrude Property Manager set:

under From, **Fig. 48**

Start Condition **Vertex**

in Select a Vertex box

click **vertex on bottom center edge of Base Flange(1), Fig. 49**

under Direction 1

End Condition **Through All**

click in the **Direction of Extrusion** box

click **angled edge of Member[3]**

check **Flip side to cut**

Direction arrow should point towards area to be cut away

under Feature Scope

unselect **Auto-select**

click **center Member**

click OK .

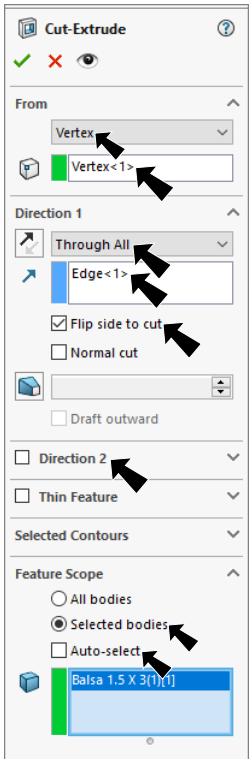

Fig. 48

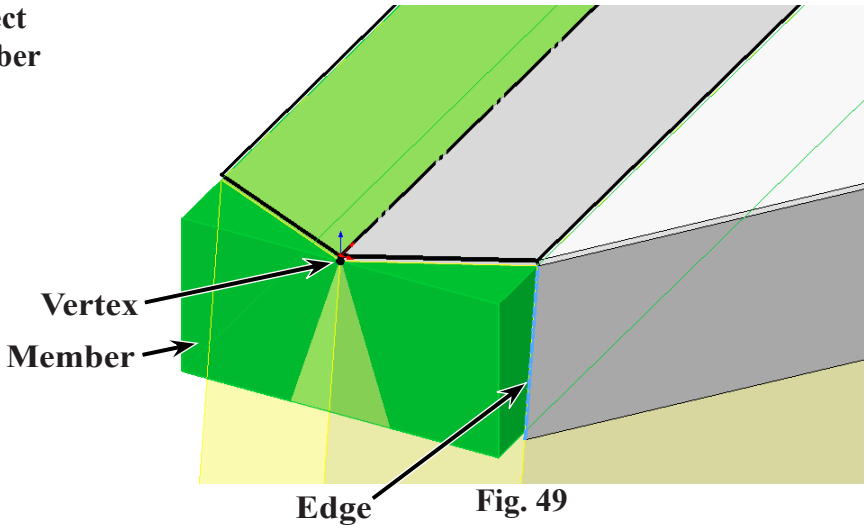

Fig. 49

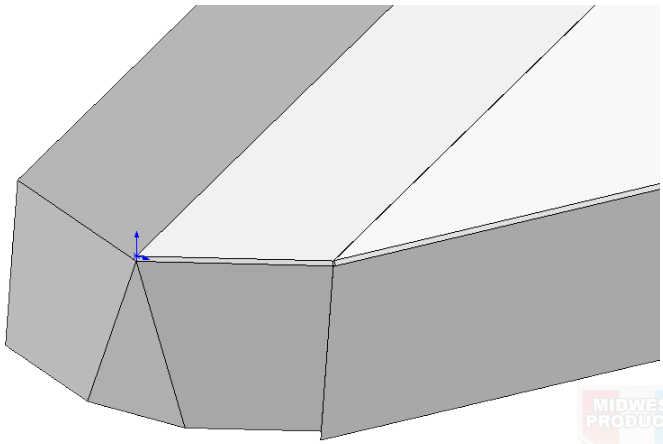

Fig. 50

L. Extruded Cut 4 (Tip).

Step 1. Click **Bottom** on the Standard Views toolbar. (**Ctrl-6**)

Step 2. Click **bottom face** of Wing sheet metal and click **Sketch** on the context toolbar, **Fig. 51**.

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

Step 4. Click **Line** (**L**) on the Sketch toolbar.

Step 5. Sketch vertical line down Wing tip, **Fig. 52**.

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

Step 7. Add the **10** dimension, **Fig. 52**.

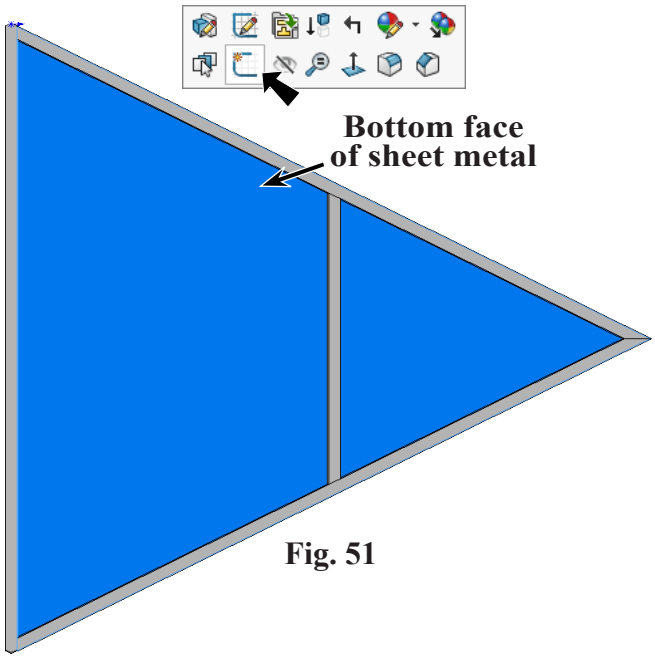

Fig. 51

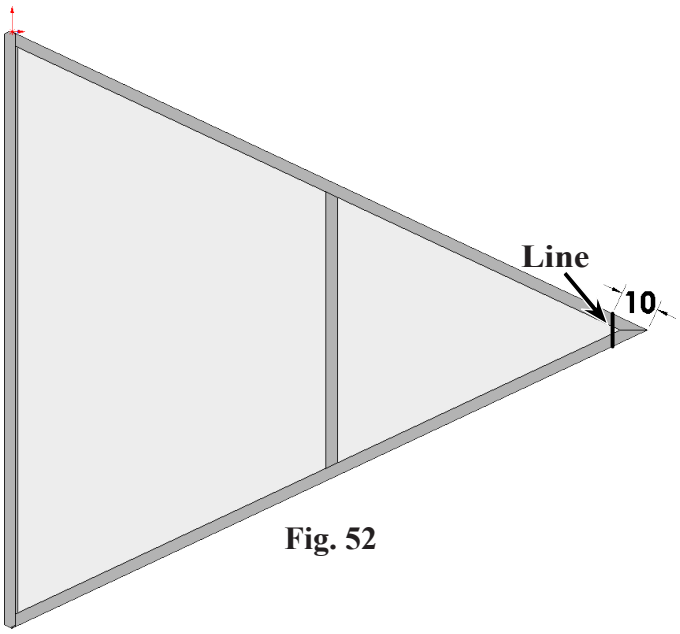

Fig. 52

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

Step 9. Click **Extruded Cut** Extruded Cut on the Features toolbar.

Step 10. In the Cut-Extrude Property Manager set:

under Direction 1, **Fig. 53**

End Condition **Through All**

click **Reverse Direction**

uncheck **Flip side to cut**

Direction arrow should point towards area to be cut away, Fig. 54. If arrow is pointing in wrong direction, check **Flip side to cut**

uncheck **Direction 2**

under Feature Scope

unselect **Auto-select**

click **Leading and Trailing Members**

click OK .

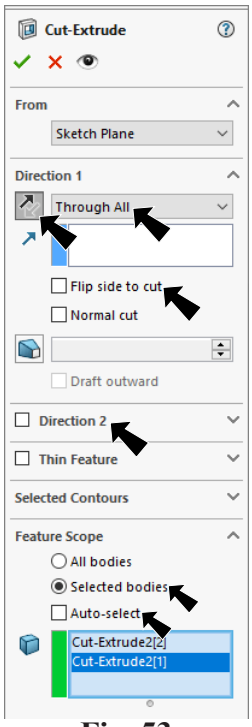

Fig. 53

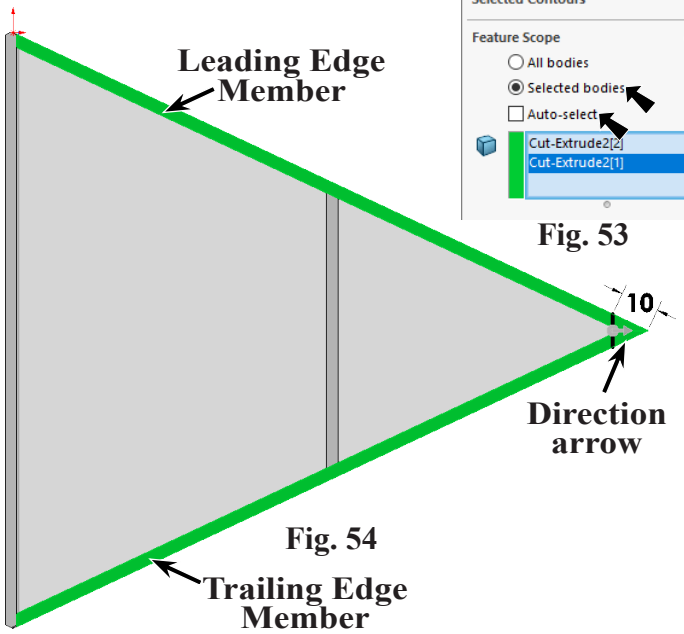

Fig. 54

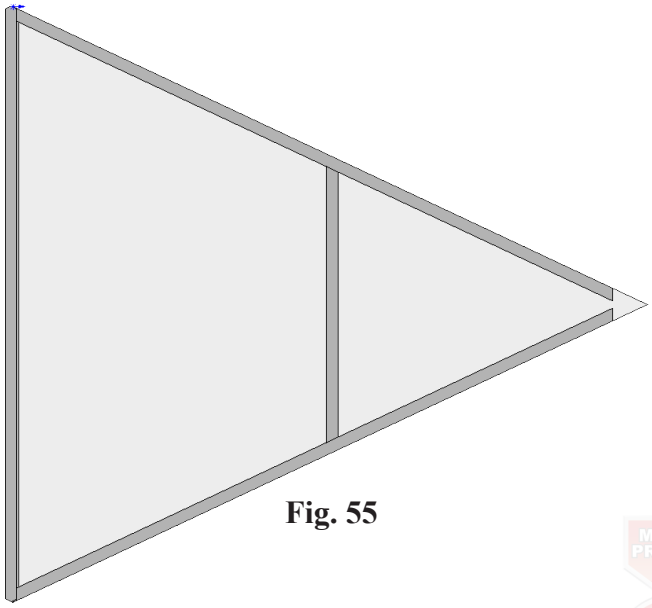

Fig. 55

M. Mapping Wood Grain Parallel with Length of Member.

Step 1. Click the **Root Edge Member** to select member, click **Appearance Callout** on the context toolbar and click **Body**, **Fig. 56**.

Step 2. In the Appearances Task pane,
expand **Appearances**, **Fig. 57**
expand **Organic**
expand **Wood**
click **Beech** and in the lower pane select **polished beech 2d**.

Step 3. In the Appearances Property Manager:
click **Vertical Member** in middle of wing, **Fig. 58**. (you should have both vertical members selected)
click **Mapping tab** Mapping, **Fig. 59**
under Mapping controls

click **Planar mapping**
Axis direction **Current View**
Rotation 90

click **Small mapping size**

Click **Keep Visible** and OK .
The Push Pin on allows other selections.

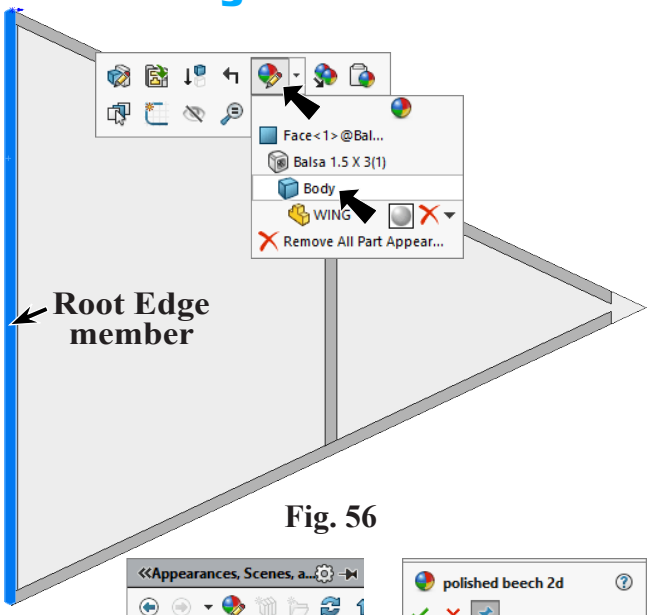

Fig. 56

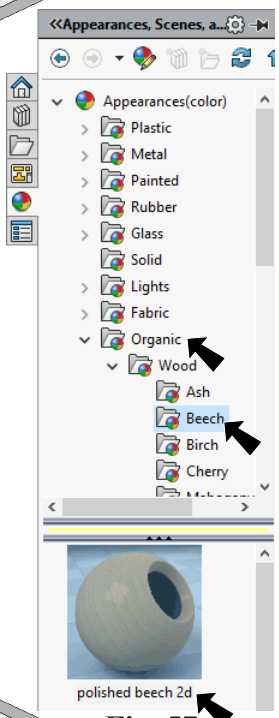

Fig. 57

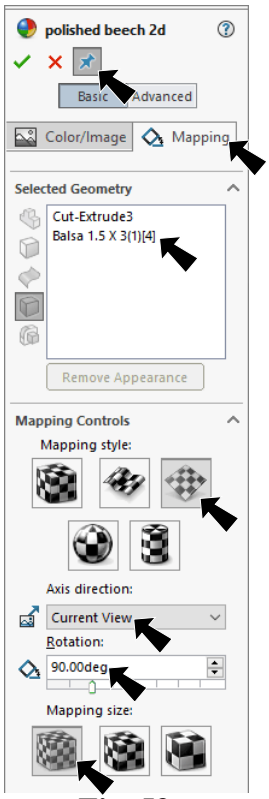

Fig. 59

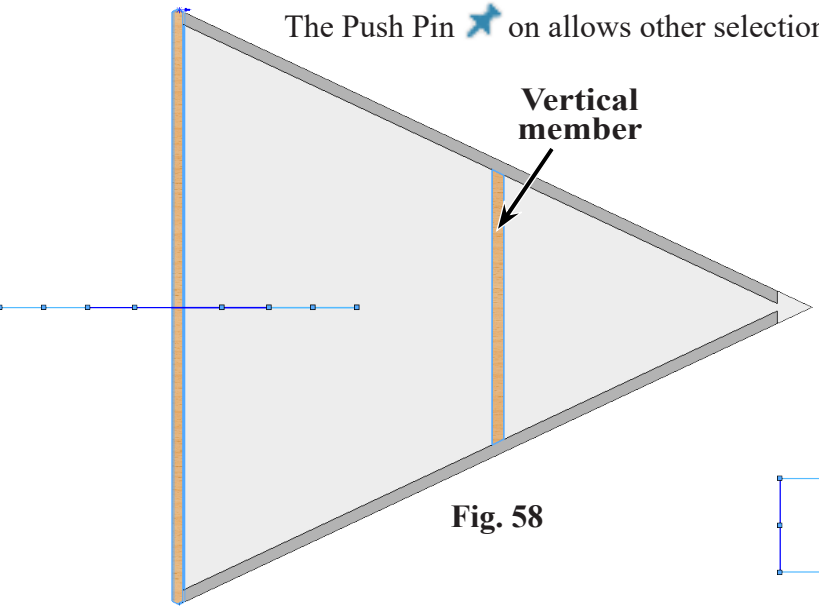

Fig. 58

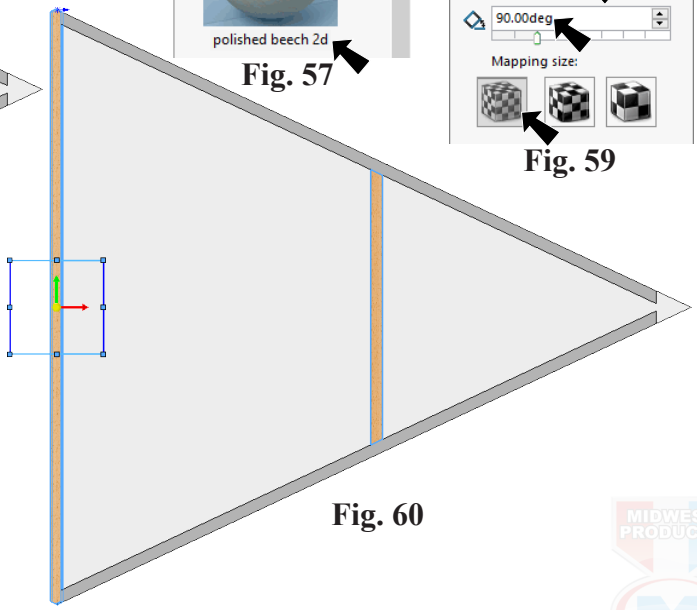

Fig. 60

Step 4. In the Appearances Property Manager:
right click in the Selected Geometry box and click **Clear Selections**, **Fig. 61**.

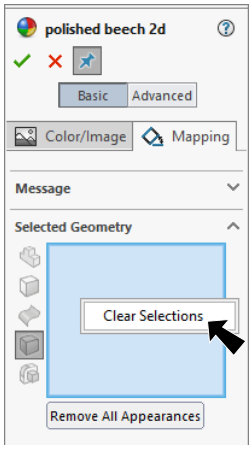

Fig. 61

Step 5. In the Appearances Property Manager set:
under Selected Geometry, **Fig. 62**
click **Leading Edge Member**, **Fig. 63**
under Mapping controls

click **Planar mapping**
Axis direction **Current View**
Rotation 154

click **Small mapping size**

click OK .

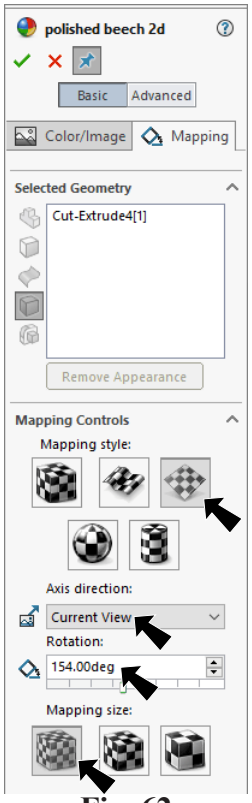

Fig. 62

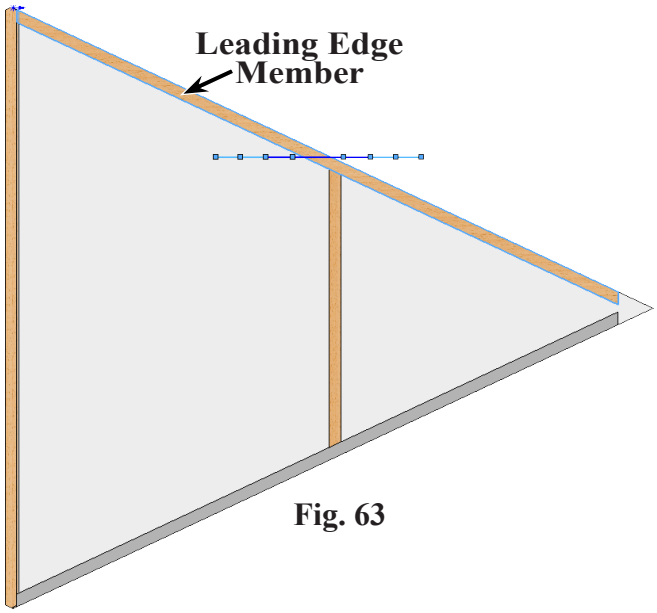

Fig. 63

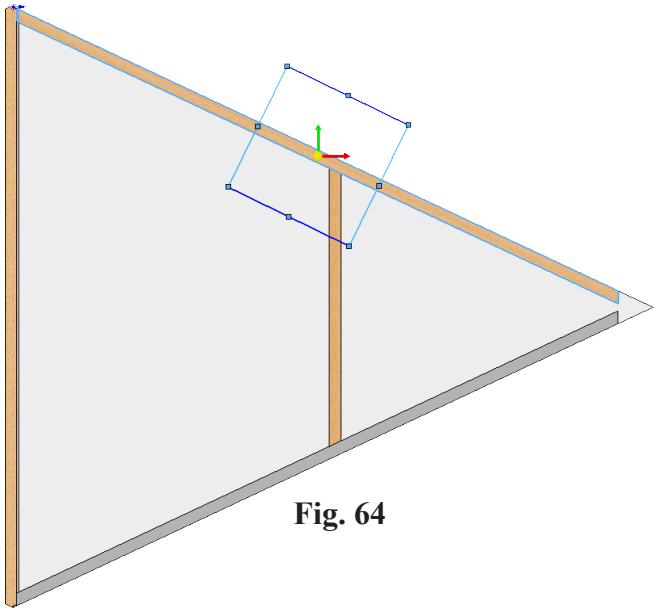
Fig. 64

Step 6. In the Appearances Property Manager:
right click in the Selected Geometry box and click **Clear Selections**, **Fig. 65**.

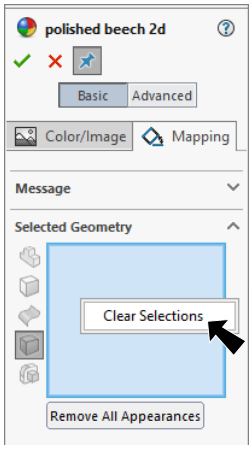

Fig. 65

Step 7. In the Appearances Property Manager set:
under Selected Geometry, **Fig. 66**
click **Trailing Edge Member**, **Fig. 67**
under Mapping controls
click **Planar mapping**
Axis direction **Current View**
Rotation 25
click **Small mapping size**
click OK and click Cancel.

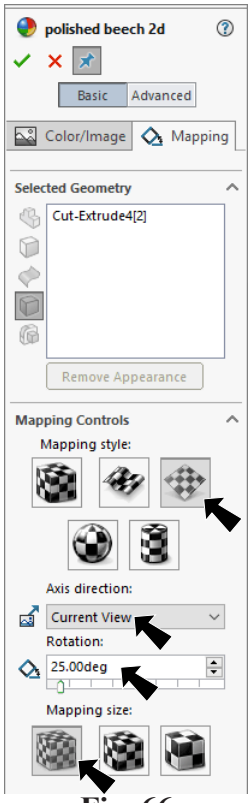

Fig. 66

Step 8. Save. Use **Ctrl-S**.

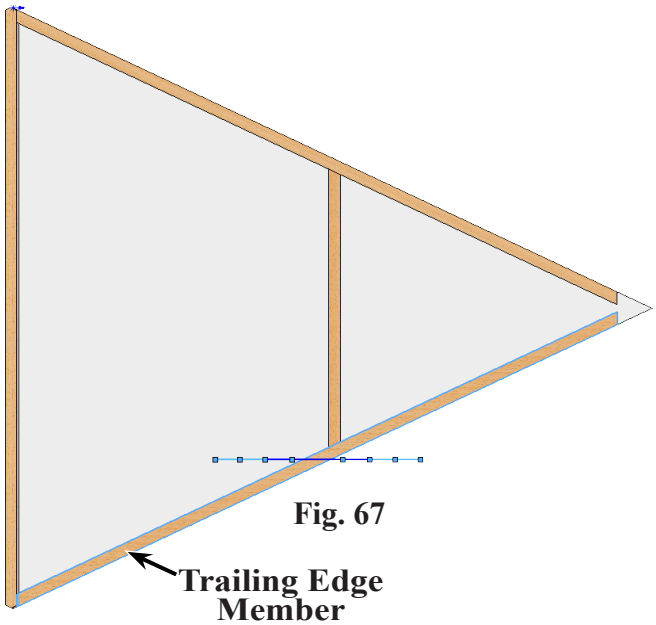

Fig. 67

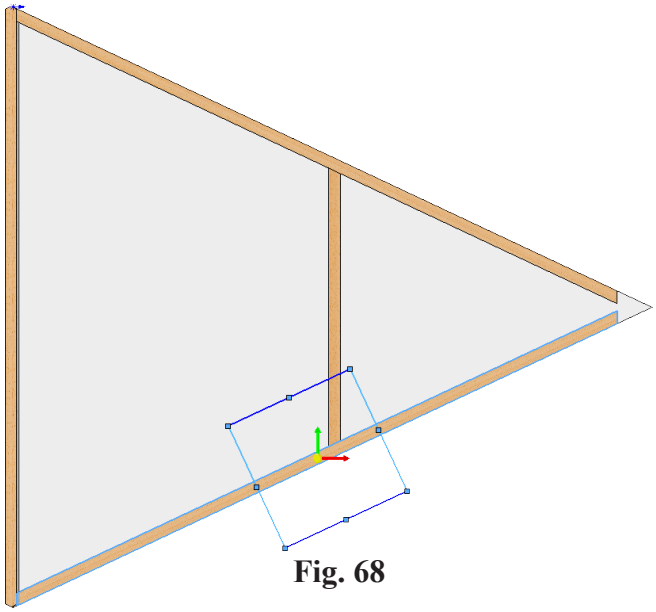
Fig. 68

N. Sketched Bends 1.

Step 1. Click **bottom face** of Wing sheet metal and click **Sketch** on the context toolbar, **Fig. 69**.

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

Step 3. Zoom in around **tip of Wing**, **Fig. 69**. To zoom, place the cursor over tip of Wing and spin the wheel on mouse back.

Step 4. Click off of face to unselect face.

Step 5. Click **Convert Entities** on the Sketch toolbar.

Step 6. In the Convert Entities Property Manager:
click **end edge of Member Fig. 71**
click OK .

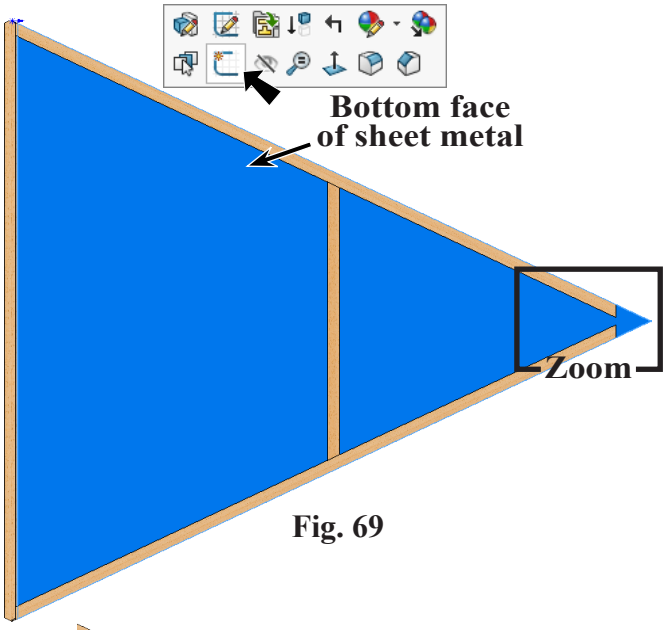

Fig. 69

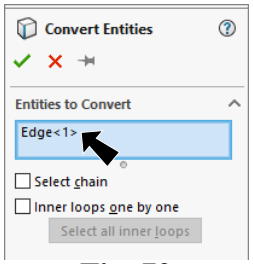

Fig. 70

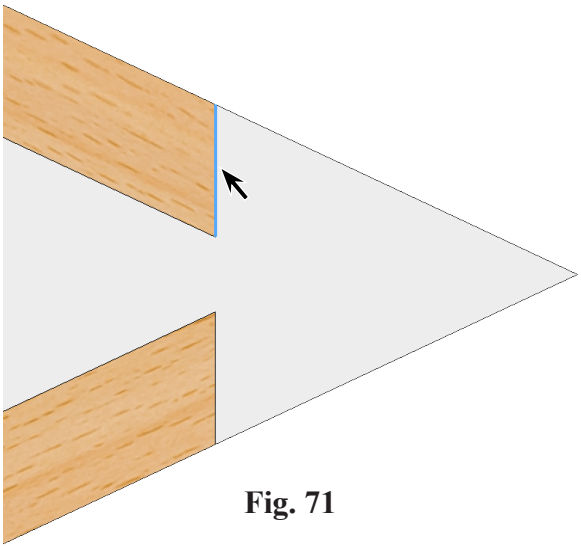

Fig. 71

Step 7. Click **Offset Entities**

on the Sketch toolbar.

Step 8. In the Offset Entities Property Manager set:
under Parameters, **Fig. 72**

Distance **1.535**
uncheck **Reverse**
click **line, Fig. 73**
The yellow offset should on right side of original line. If it is not, check Reverse.

Click **Keep Visible**
and OK .

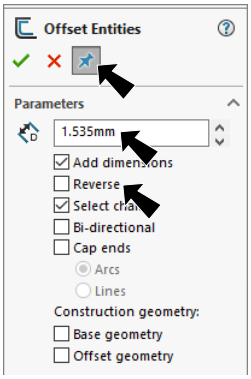

Fig. 72

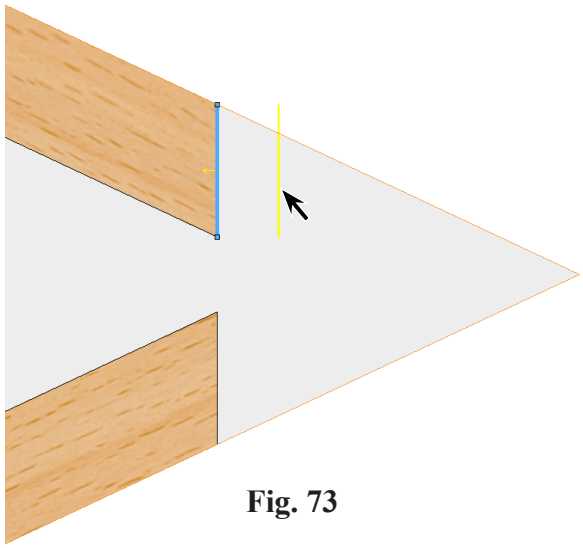
Fig. 73

Step 9. In the Offset Entities Property Manager set:
under Parameters, **Fig. 74**

Distance **2.75**
click **offset line**, **Fig. 75**
click OK **twice**.

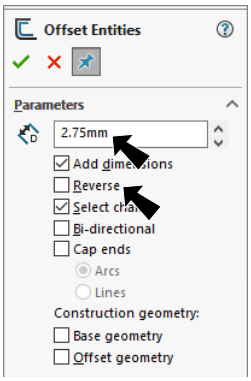

Fig. 74

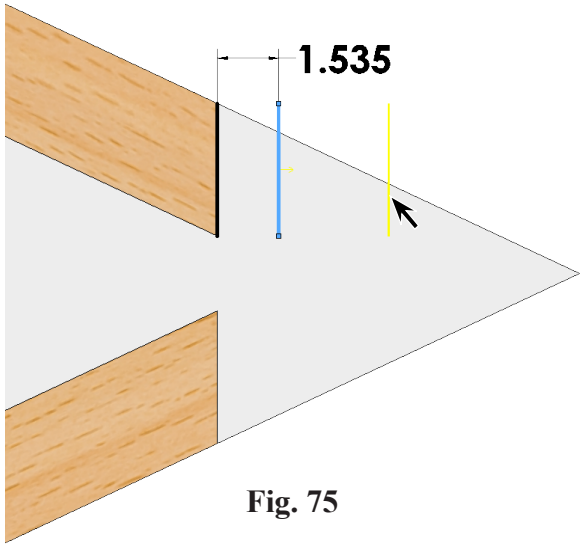

Fig. 75

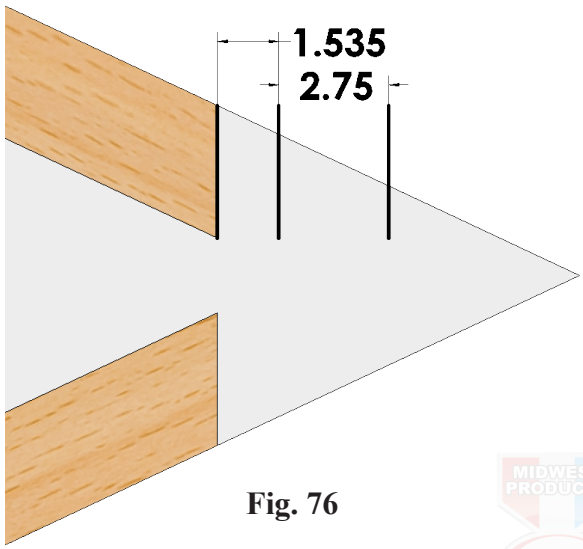

Fig. 76

Step 10. Click **Sheet Metal** Sheet Metal on the Command Manager toolbar.

Step 11. Click **Sketched Bend** Sketched Bend on the Sheet Metal toolbar.

Step 12. In the Sketched Bend Property Manager set:
under Bend Parameters, **Fig. 77**

in the **Fixed Face** box
click the **face of sheet metal inboard of bend lines**, **Fig. 78**

Bend position: **Material Outside**
Bend Angle 90
The Direction arrow should point up.

If arrow is pointing in wrong direction, click **Reverse Direction** .

Click OK .

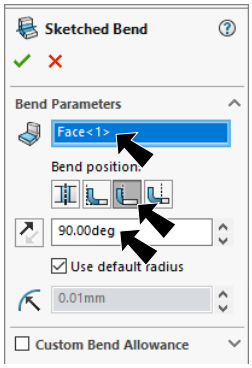

Fig. 77

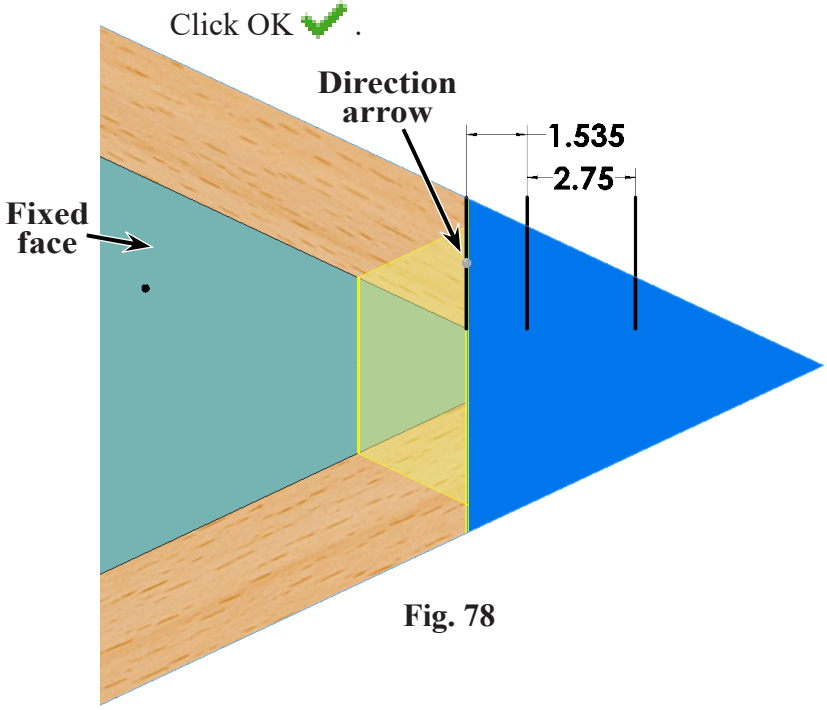

Fig. 78

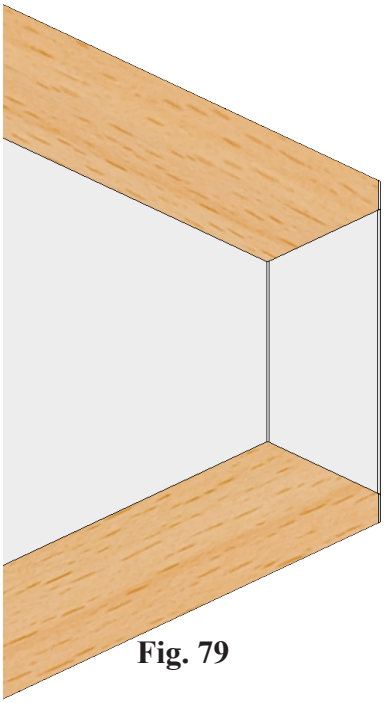

Fig. 79

O. Sketched Bend 2.

Step 1. Rotate view to view **face of bend on inside of Wing**, **Fig. 80**. Hold down middle mouse button (wheel) and drag.

Step 2. Zoom in around **bends**, **Fig. 80**.

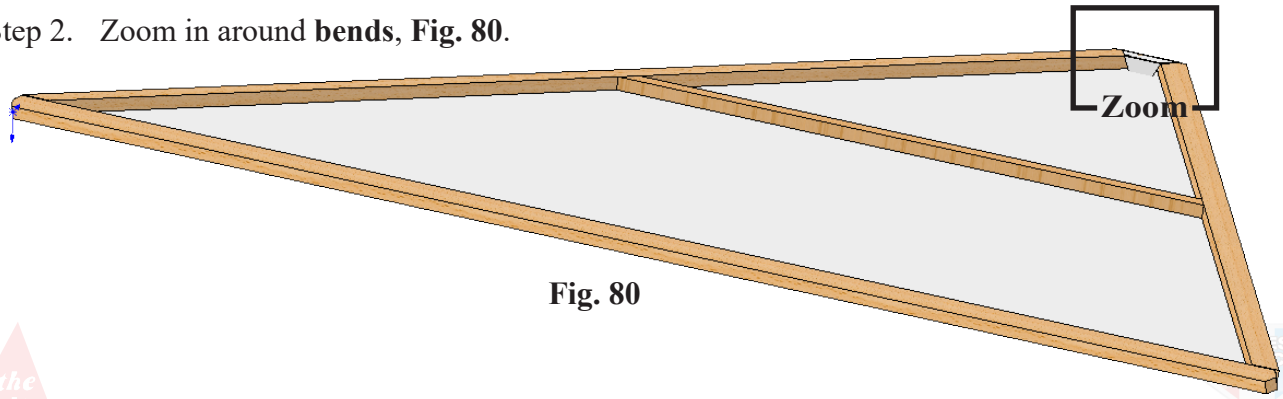

Fig. 80

Step 3. Click **face inside** of sheet metal and click **Sketch** on the context toolbar, **Fig. 81**.

Step 4. Click off of face to unselect face.

Step 5. Click **Convert Entities** on the Sketch toolbar.

Step 6. In the Convert Entities Property Manager:
click **bottom edge on left Member**, **Fig. 83**
click OK .

Step 7. Click **Sheet Metal** on the Command Manager toolbar.

Step 8. Click **Sketched Bend** on the Sheet Metal toolbar.

Step 9. In the Sketched Bend Property Manager set:
under Bend Parameters, **Fig. 84**
click the **face of bend on inside**, **Fig. 85**
Bend position: **Material Inside**
Bend Angle 90
click OK .

Step 10. Save.
Use **Ctrl-S**.

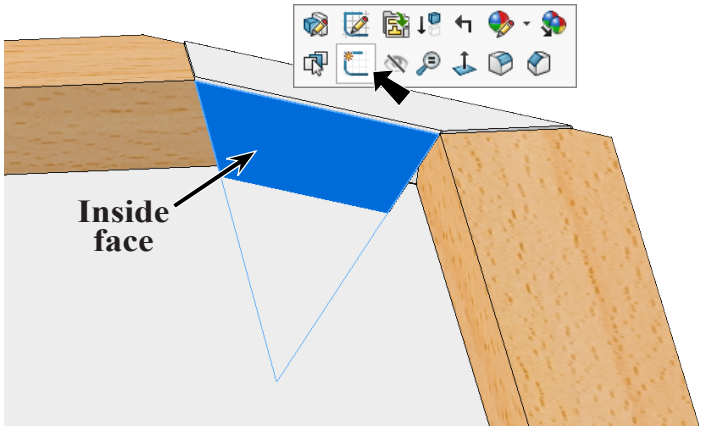

Fig. 81

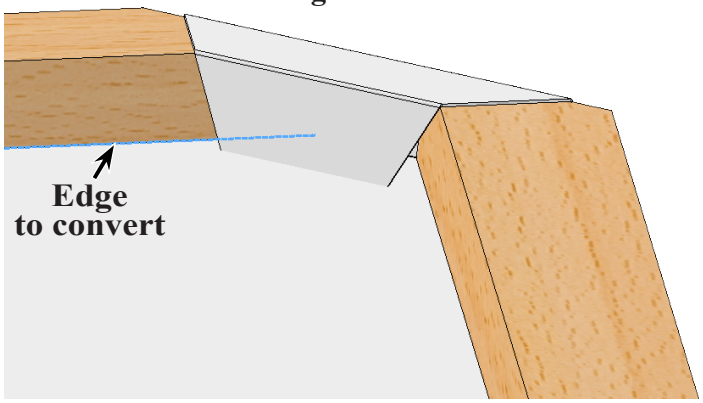

Fig. 83

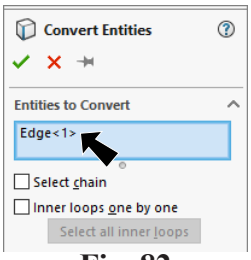

Fig. 82

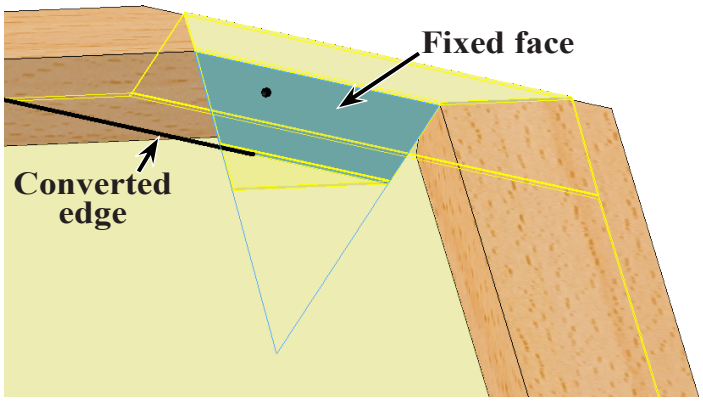

Fig. 85

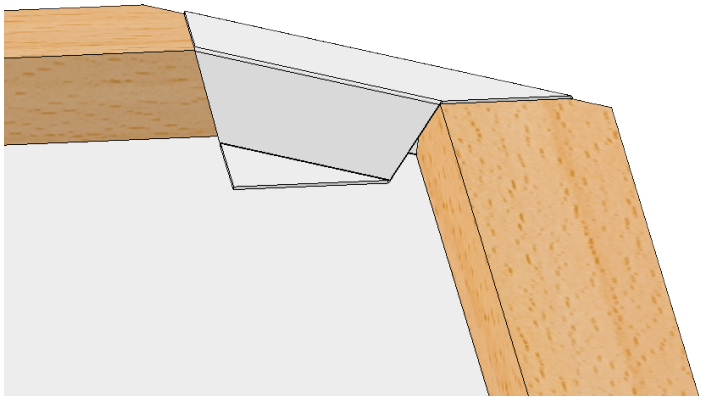

Fig. 86

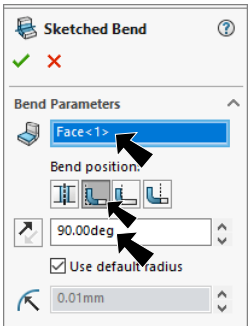

Fig. 84

P. Mirror Structure Member Bodies.

Step 1. Click **Trimetric** on the Standard Views toolbar.

Step 2. Select the **Right Plane** and **last three Structure Member Balsa** in the Feature Manager, **Fig. 87**.

To make selection, expand **Structure Member Balsa** in the Feature Manager.

Ctrl click last three Balsa bodies and Ctrl click Right Plane.

The first **Balsa body** is the center Member and we don't need to mirror that Member.

Step 3. Click **Mirror** on the Features toolbar.

Step 4. Click OK in Mirror Property Manager, **Fig. 88**.

Step 5. Save. Use **Ctrl-S**.

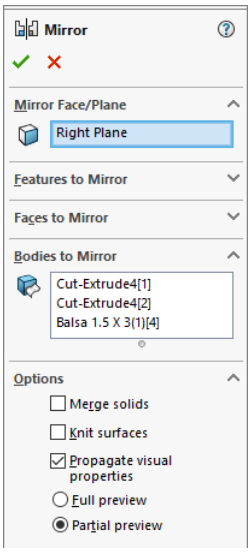

Fig. 88

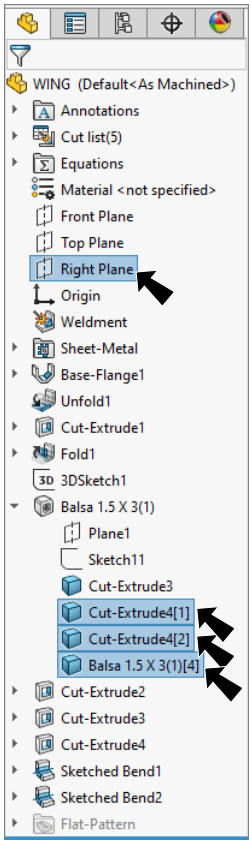

Fig. 87

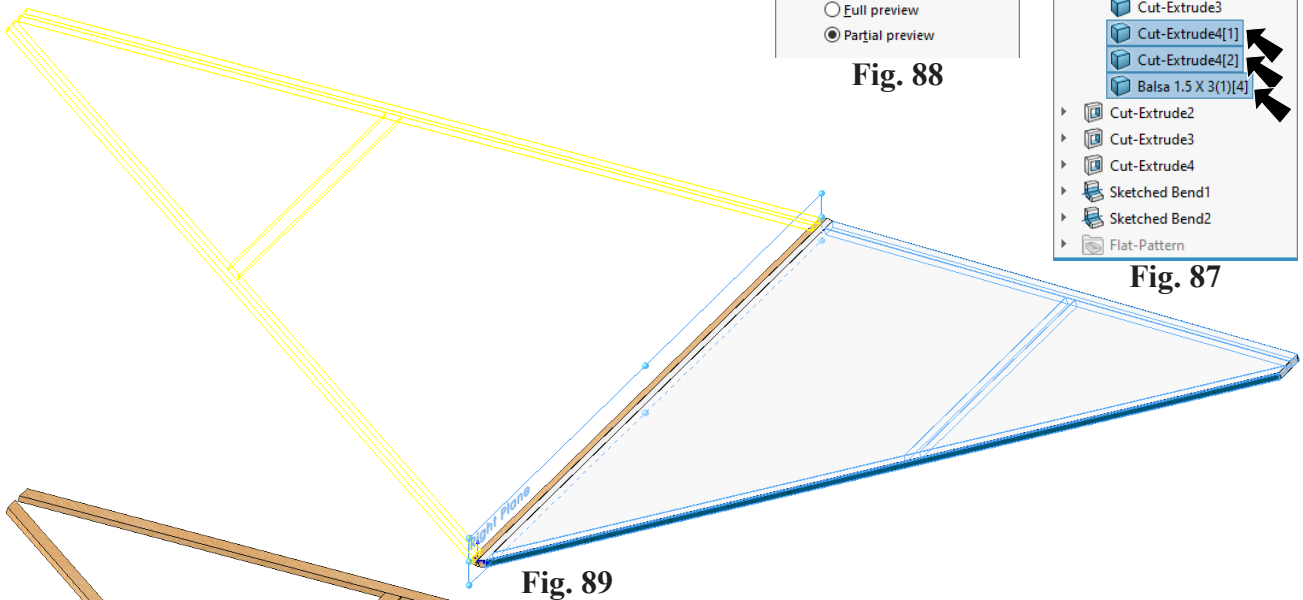

Fig. 89

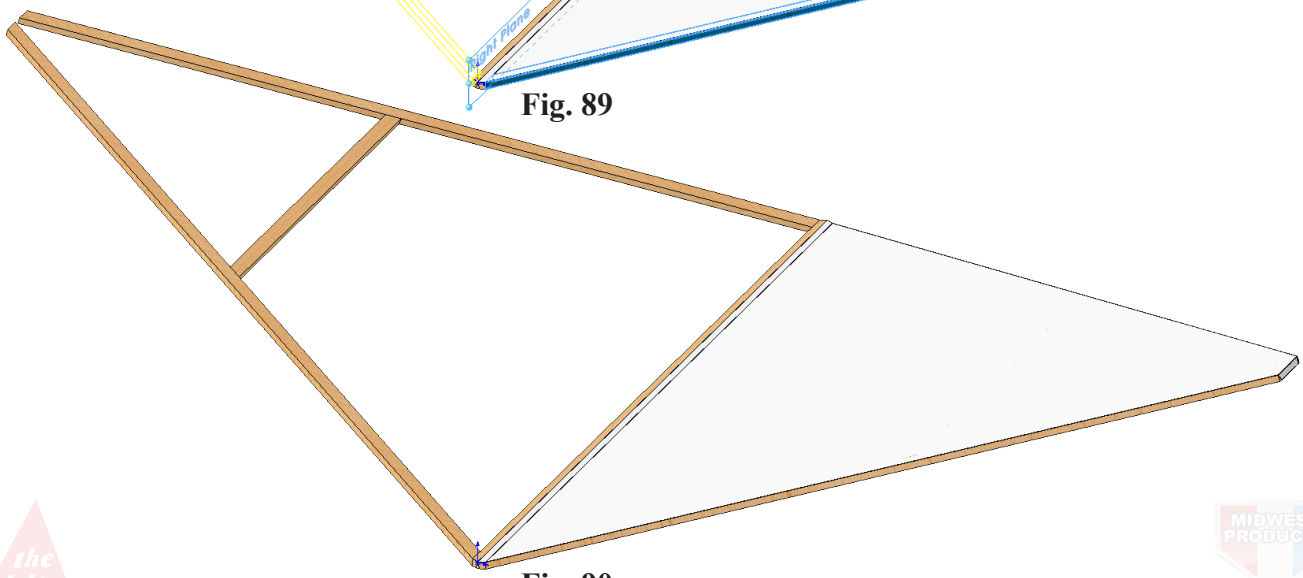

Fig. 90

Q. Mirror Sheet Metal.

Step 1. Select the **Right Plane** in the Feature Manager, **Fig. 91**.

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

Step 3. In the Mirror Property Manager set:
expand **Bodies to Mirror**, **Fig. 92**
click the **sheet metal**, **Fig. 93**
under Options
check **Merge solids**
click OK .

Step 4. Save. Use **Ctrl-S**.

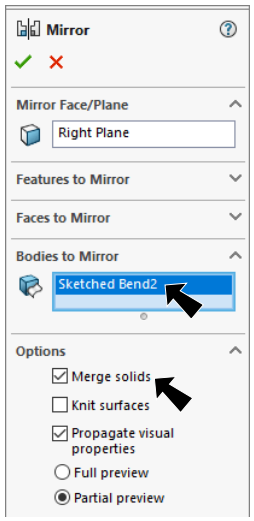

Fig. 92

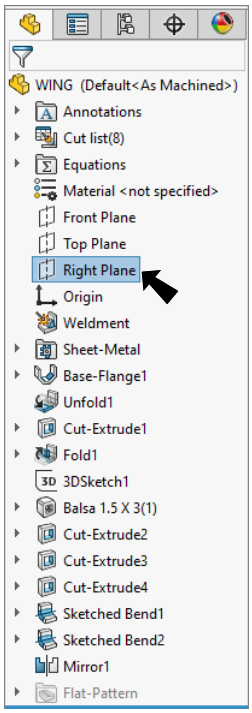

Fig. 91

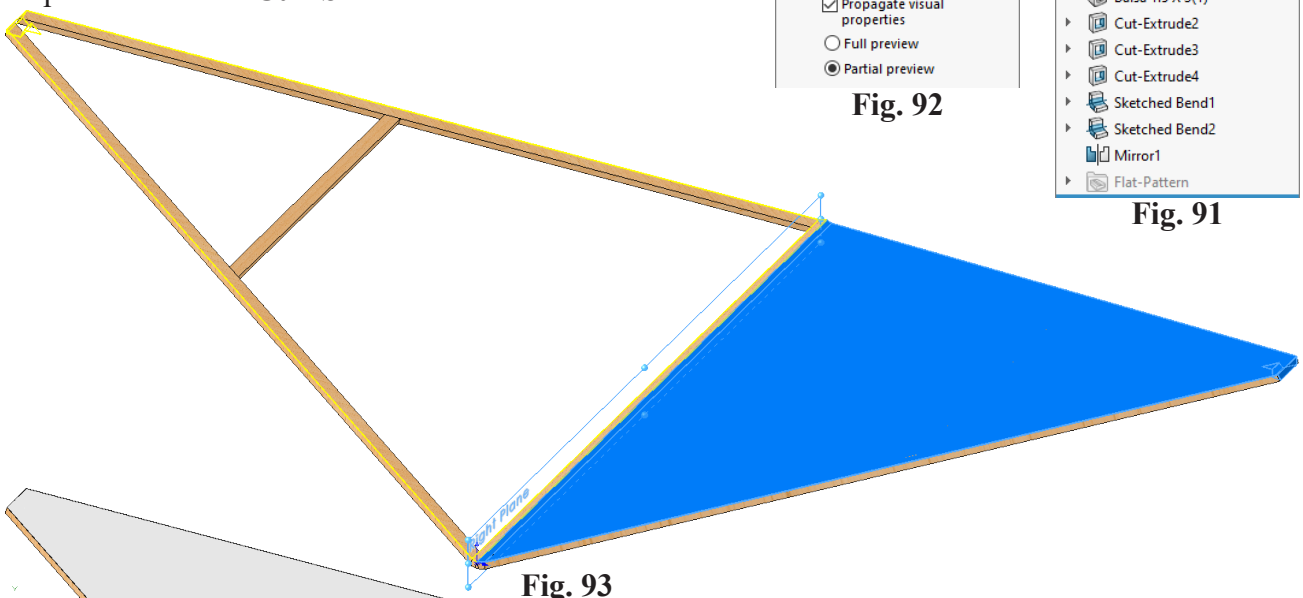

Fig. 93

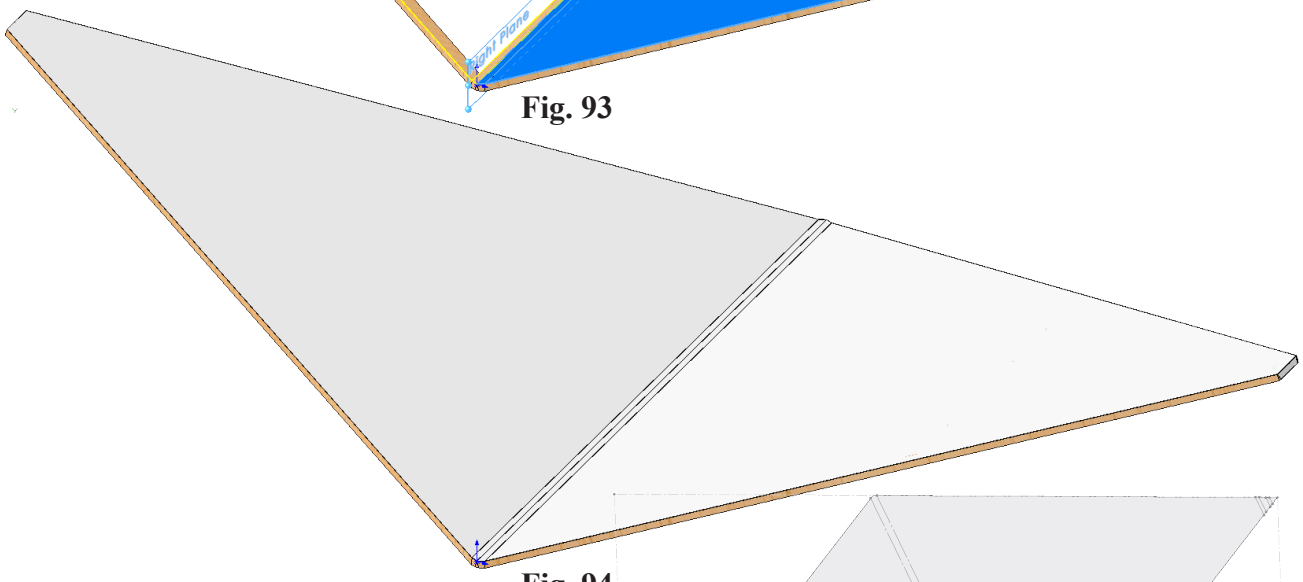

Fig. 94

Step 5. Confirm the sheet metal flattens.
Click **Flatten** Flatten on the Sheet Metal toolbar and switch to **Left** .
Turn off Flatten Flatten .

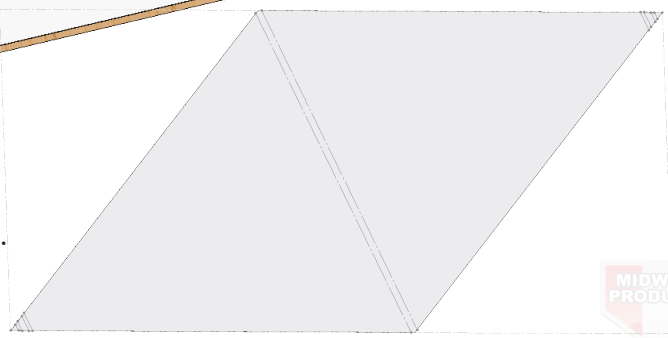

Fig. 95