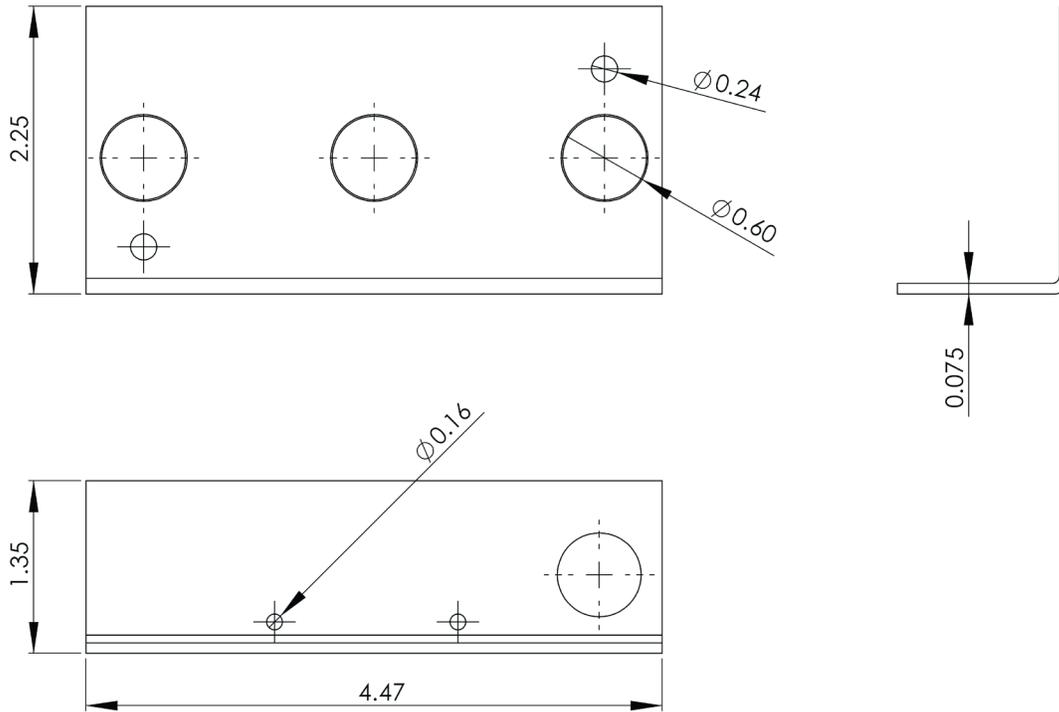


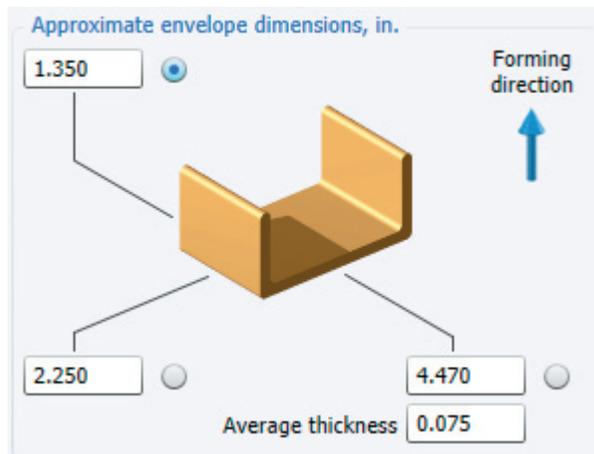
# Sheet Metalworking Analysis

In this tutorial, we follow the steps used to create a turret press and a compound die analysis for the part modeled in the sample file **sheet metal stamped part.dfm** included with your installation (`\data\samples`) of DFM Concurrent Costing.



## A turret presswork analysis

1. Start a new analysis in DFM Concurrent Costing.
2. In the Part Description panel, enter **end plate** for the *Part name*, press the tab key twice to move to the *Life volume* field. Enter **25000**.
3. For *Envelope shape*, choose the stepped block. Enter the dimensions as shown below.



4. With this data entered, click the **Select process and material** button.
5. For the process choose the *Sheet metal stamping* category and the *Turret press* process. Verify the Manufacturing profile is set to BDI North America. For material, choose *Low carbon steel, cold rolled, commercial quality* from the *Carbon steel* category. Click the **OK** button to calculate some preliminary results.

- 6. The focus on the Process Chart is now *Turret pressworking* and the Responses Panel on the right has default data from the Part Description panel and the Machine and Material libraries.
- 7. We are now going to replace some of the default information used in the original estimate to improve the accuracy of the results. In the *Basic data* section, change the *Batch size* to **2500**.
- 8. Notice that an optimal sheet size has been selected, with the number of parts per sheet calculated from the sheet size. The software has also estimated the unfolded length and width of the part.
- 9. We can more accurately define the flattened dimensions. In the *Part basic data* section, change *Unfolded length* to **4.47**; and enter **3.6** for *Unfolded width*.

Part basic data	
Unfolded length, in.	4.470
Unfolded width, in.	3.600
Length overlap, in.	0.000
Width overlap, in.	0.000
<input checked="" type="checkbox"/> Mutually exclusive overlaps?	

- 10. Click the **Calculate** button, to apply these changes to the *Cost results* box.
- 11. Note the next data box, *Additional setups*, where the software has specified an additional machine setup, a press brake, to form the bend. We accept this, and move to the data box, *Turret pressworking blank data*.

### Completing part geometry data

- 1. To specify part geometry data, click the calculator button located next to the appropriate field.
- 2. First we will define the area of the blank. Click the button next to the Area of Blank field.
- 3. On the *Shapes* toolbar, click the rectangle button to add the rectangular area to the Geometry Chart. Press the **Tab** key to accept the name. On the right panel, enter its dimensions, **2.25** and **4.47**. Tab to move from field to field. Click the rectangle button again, and enter the dimensions **1.35** and **4.47**. Notice the total area of **16.092** in the lower left box. The checkbox indicates whether or not we want to transfer this data to the Responses Panel.

The Chart now looks like this:

Rectangular area

Rectangular area

Dimensions, in.

1.350

4.470

Repeat count: 1

Area, in<sup>2</sup>: 6.035

Area of blank

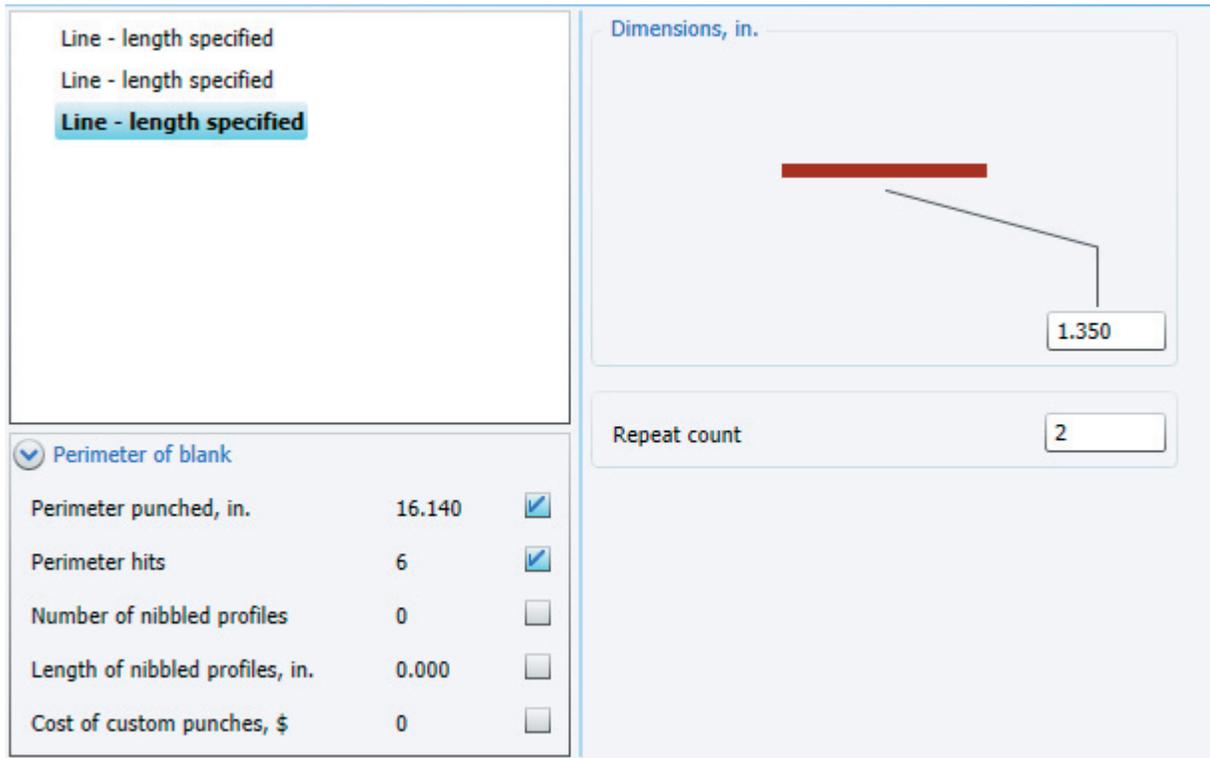
Area of blank, in<sup>2</sup>: 16.092

- Click **OK**. Notice that the total area of the blank has been transferred from the calculator to the *Area of blank* field.
- Now click the  for the *Perimeter punched* field.
- This calculator toolbar contains a set of buttons for inputting lines, arcs and profiles. You can use the Group button to organize shapes. For this rectangular part, click the toolbar button Line-length specified 3 times, to add 3 line segments, to the Geometry Chart.

Enter the line length and repeat count for each entry as follows:

Line length	Repeat
4.47	2
2.25	2
1.35	2

Notice the perimeter totals have been calculated in the lower left box.



The screenshot shows the software interface. On the left, the Geometry Chart displays three entries: "Line - length specified", "Line - length specified", and "Line - length specified" (highlighted). Below this is a summary table for "Perimeter of blank":

Perimeter of blank		
Perimeter punched, in.	16.140	<input checked="" type="checkbox"/>
Perimeter hits	6	<input checked="" type="checkbox"/>
Number of nibbled profiles	0	<input type="checkbox"/>
Length of nibbled profiles, in.	0.000	<input type="checkbox"/>
Cost of custom punches, \$	0	<input type="checkbox"/>

On the right, the "Dimensions, in." section shows a diagram of a rectangular part with a horizontal dimension of 1.350 and a vertical dimension of 2. Below the diagram, the "Repeat count" is set to 2.

- Since we hadn't entered any profiles, these checkboxes remain unchecked and will not be transferred. Click **OK** to transfer the Perimeter punched and Perimeter hits to the Responses fields.
- To determine the area and perimeter of punched holes, click the  next to *Number of punched holes* in the *Turret pressworking features data* group. In this calculator, add 3 entries for circular holes from the toolbar. The diameter and repeat count for each are as follows:

Diameter of hole	Repeat
.24	2
.6	4
.16	2

- Observe the totals for holes punched, including the number of holes, the area of holes and the number of punches required. In this example, all the holes are regular and can be created with standard punches. No custom punches are necessary. Click **OK**.

Circular hole  
Circular hole  
**Circular hole**

Dimensions, in.



0.160

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**▼ Holes produced on turret press**

Number of punched holes	8	<input checked="" type="checkbox"/>
Area of holes, in <sup>2</sup>	1.262	<input checked="" type="checkbox"/>
Punched hole hits	8	<input checked="" type="checkbox"/>
Holes custom punch cost, \$	0	<input checked="" type="checkbox"/>
Number of nibbled profiles	0	<input checked="" type="checkbox"/>
Length of nibbled profiles, in.	0.000	<input checked="" type="checkbox"/>

**Hole production method**

Standard punch - single hit  
 Custom punch - single hit

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Repeat count

Area, in<sup>2</sup>

Perimeter, in.

- To complete the Geometry Calculator entries, click the  next to the *Number of bends* in the *Press brake 1 data* group. Add a bend by clicking the bend button (the only button available) and entering the length of **4.47**. Click **OK**.

The geometry specifications are now complete for this part.

### Updating the results

- On the Responses Panel, when the *Turret pressworking* is highlighted on the Process Chart, the data entered in the Calculators has been transferred and locked so it will not change value when a Calculate is done. Here is the transferred data from the *Area of blank* and *Perimeter punched* geometry calculators.

**Turret pressworking blank data**

Area of blank, in <sup>2</sup>	<input type="text" value="16.092"/>
Perimeter punched, in.	<input type="text" value="16.140"/>
Perimeter hits	<input type="text" value="6"/>
Number of nibbled profiles	<input type="text" value="0"/>
Length of nibbled profiles, in.	<input type="text" value="0.000"/>
Cost of custom punches, \$	<input type="text" value="0"/>

- Similarly, the data we calculated on the *Punched holes* and *Number of bends* calculators has been copied to the *Turret pressworking features data* box.

Turret pressworking features data	
Number of punched holes	8
Area of holes, in <sup>2</sup>	1.262
Punched hole hits	8
Holes custom punch cost, \$	0
Number of nibbled profiles	0
Length of nibbled profiles, in.	0.000
Number of punched form features	0
Form feature hits	0
Form features custom punch cost, \$	0
Number of punched bends	0
Bend hits	0
Bends custom punch cost, \$	0
Press brake 1 data	
Number of bends	1
Length of bend lines, in.	4.470

3. Click the **Calculate** button to update the *Cost results*; the turret press portion of the analysis is complete.
4. Change the name on the tab from *Original* to *Turret*. Double-click in the tab name to put it into edit mode, type and press the **Enter** key.
5. Save your analysis (*File* menu→*Save*.) Name the file by typing **endplate new** into the *File name* field in the Save dialog. Click the **Save** button.

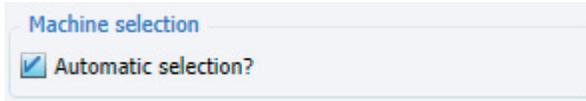
### The setups for the turret pressworking analysis

The software has automatically added two machine setups for completing the cost analysis. Each of these setups and the operations completed on them has response data which can be edited. No further changes are necessary for this part, but we will review one of the setups.

1. Click the *Trumpf TruPunch 1000 turret press* on the Process Chart.

- ▲ Low carbon steel, cold rolled, commercial quality sheet metal part
  - ▲ Turret pressworking
    - ▲ **Trumpf TruPunch 1000 turret press**
      - Load and unload sheet
      - Punch outer perimeter
      - Punch holes
    - ▲ Piranha 125 ton 10 foot P series press brake
      - Acquire and set-aside part
      - Form bends

- In the responses on the right panel you can edit the data for the turret press. Notice that the first response, *Machine selection*, is a checkbox for *Automatic selection?* of the machine.



This means that the software automatically selects an appropriately sized machine from the Machine Library. The turret press chosen for this analysis was automatically selected by the software because it was the least expensive turret press in the Machine Library that could process the 0.075 inch thick, 48 inch long by 36 inch wide sheet used to make the endplates.

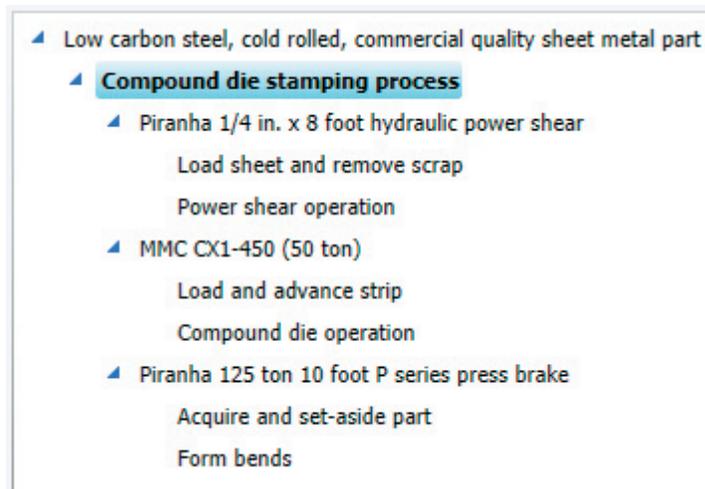
- The setup rates and times for this machine are set in the *Load and unload sheet* operation under the setup entry, shown on the next page.



Now we are going to change the sheet metal process type and do a cost comparison of the two processes.

## A compound die analysis

- Make a copy of the turret press analysis (Click the tab. *Edit->Copy, Edit->Paste*)
- A copy is created at the second tab of the Process Chart. Double-click the new tab and type **Compound** for the name and press the **Enter** key.
- With *Low carbon steel, cold rolled, commercial quality sheet metal part* highlighted on the Process Chart, click the **Select process and material** button.
- In the selection window, in the *Sheet metal stamping* category, choose *Compound die* for the process. For the material, again choose the *Carbon steel* category, *Low carbon steel, cold rolled, commercial quality*.
- Click the **OK** button in the selection window. The Process Chart now appears:



- The *Compound die stamping process* is highlighted on the Process Chart. There are three setups now: the separate bend forming setup is still needed, and there is now an additional power shearing setup for cutting the sheet into strips for processing.
- Notice on the Responses Panel that response fields common to both processes have been transferred from the Turret process to the Compound die stamping process. In the *Part basic data* box, the unfolded length and width of the part have been copied from the turret analysis. The additional response, *Processing direction*, lets you indicate the part unfolded dimension that will lie along the strip length. The default *Processing direction* gives the optimal part layout, which will result in maximum material utilization.
- In the *Additional setups* box, the values from the turret analysis have been copied. We are going to make a change here, because of the different capabilities with a stamping setup. Change the *Press brake* value to **0** and the *Die bend forming* value to **1**. Click the **Calculate** button. The software has replaced the press brake setup with a 32 Ton Minster stamping press for the die bend forming operation.

**Additional setups**

Hole punching	0
Form feature punching	0
Combination punch operation	0
Die bend forming	1
Press brake	0

- In the next data box, *Compound die operation data*, the geometry values have been copied from the turret analysis.

**Compound die operation data**

Area of blank, in <sup>2</sup>	16.092
Perimeter of blank, in.	16.140
Number of holes	8
Area of holes, in <sup>2</sup>	1.262
Perimeter of holes, in.	10.053
Number of form features	0
Perimeter of form features, in.	0.000

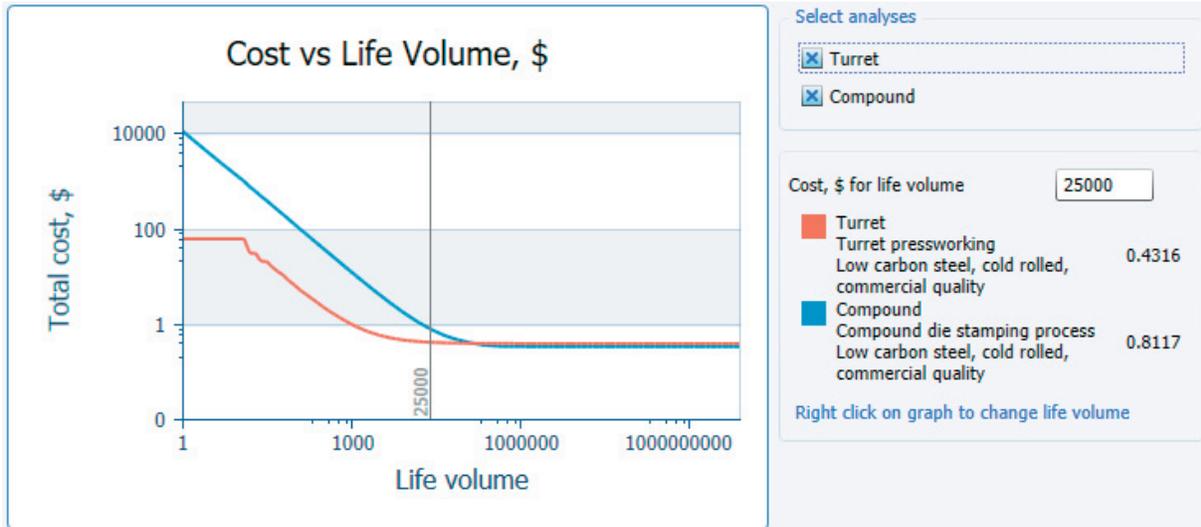
- With the *Compound die stamping process* still highlighted on the Process Chart, we need to edit the *Form bends 1 data* box. Edit the *Number of bends* to **1**; and the *Length of bend lines* to **4.47**. When we switched to a die bend forming operation from a press brake, the software did not assume the bend is the same. As with the other geometry features, it is not required that you use the Geometry Calculator to enter the dimension (or total dimensions) for the bends.
- Click the **Calculate** button to update the *Cost results*. Highlight the top entry on the Process Chart to see the total *Cost results*:

Cost results, \$	Previous	Current
Material	0.1547	0.1547
Setup	0.0366	0.0400
Process	0.1671	0.1565
Rejects	0.0034	0.0033
Piece part	0.3618	0.3545
Tooling	0.3504	0.4572
<b>Total</b>	<b>0.7122</b>	<b>0.8117</b>
Tooling investment	8,759	11,430

## Reviewing results

When you have two or more analyses in a file, you can compare the results. One way is the graph *Cost vs. Life Volume*.

1. With the **endplate new** file still open, choose *Cost vs. Life Volume* from the *Results* menu.
2. Once the graph data has loaded, check the other analysis to compare them. You can see at a glance that the break-even point between the two processes, indicated by the intersection of the two curves, is about 140,000 parts. This means if the life volume is less than 140,000 parts, a turret press process using general-purpose tooling would be most cost effective. A compound die process, with its greater up-front tooling investment, becomes more economical as the life volume increases over 140,000 parts.



4. To print the graph as a report, choose *Print Preview* from the *Graphs* menu. The Graph report includes a breakdown table of comparative costs.
5. Before printing, review the report options to provide your report with customizable headings and other print features (*Print Preview Results* menu→*Report options*.)