Types of stamping dies

https://www.youtube.com/watch?v=5CuJjSk4U38

Simple Die

- Hand Fed
- One hit operation
- Secondary operations
Compound Die

- Washer die
- Perforating & blanking in one hit
- Leaves all burrs in one direction

Combination Die

- Knock out
- Blanking Punch
- Stripper
- Die ring
- Drawing die
- Metal plate
- Pad
Transfer Dies

The large sheet metal part is transferred to next station after an operation by transfer machine.
Components

RAM (slide) -> Shank -> Back up plate
Guide post bushing
Punch plate -> Punch -> Punch holder (upper shoe)
Guide post
Punch plate
Die holder (lower shoe) -> Packing
Die block -> Bolster plate
Blank
Bed or press
Shearing force \( P = St \)

where \( S \rightarrow \) shear stress of sheet material
\( l \rightarrow \) perimeter of cut area
\( t \rightarrow \) thickness of blank

for single circular hole \( l = \pi d \)
for making a washer (when both punches move simultaneously)
\( l = \pi (L + d) \)
for rectangular hole \( l = 2(a + b) \)
for square hole \( l = 4a \)

The capacity of press for shearing force \( P \)

\[ = P \times C \]

where, \( C \rightarrow \) energy losses other than shearing factor

\( \rightarrow 1.1 \text{ to } 1.5 \) for normal to narrow profile
\( \rightarrow 1.25 \text{ to } 1.75 \) for \( d/t < 2 \)

Energy in press work \( E = P \times C \times \text{punch travel} \times K \times t \)

\( K \rightarrow \% \) penetration required to rupture

Press power \( = \frac{E \times \text{actual no. of strokes per minute}}{60 \times \text{press efficiency}} \)

Horizontal force \( P_H = (0.15 \text{ to } 0.25) \times P \) for normal clearance
\( \text{on punch side} = (0.4 \text{ to } 0.6) \times P \) for close clearance
Methods of reducing cutting forces in punching/blanking

1. **Shear**: The faces of punch are ground off so that a part of the punch would cut the material at any moment. This will reduce punch contact area and eventually the cutting force. The shear can be provided in punch as well as dies.

   **Blanking → Die shear**
   **Punching → Punch shear**

   When no shear is given on the punch:
   \[ E = P \times C \times K \times t \]

   When shear is given on the punch or die:
   \[ E' = P' \times C \times (Kt + I) \]

   Since work done will remain same:
   \[ PKt = P'(Kt + I) \]
   \[ I = \frac{(P - P')Kt}{P'} \]
   \[ P' = \frac{PKt}{Kt + I} \]

   \[ \left\{ \begin{array}{l}
   I = \frac{(P - P')Kt}{P'} \\
   P' = \frac{PKt}{Kt + I}
   \end{array} \right. \] for single & double shear

   When \( I \gg Kt \)

   Actual shear force \( P' = \frac{PKt}{I} = P \times m \)

   \[ m = \frac{Kt}{I} = 0.2 \text{ to } 0.6 \text{ when } I = t \]
   \[ I = 0.2 \text{ to } 0.4 \text{ when } P = 2t \]

**Staggering of punch**: One punch should penetrate at a time. (lengths of punches need change)
Centre of Pressure

While blanking/punching irregular contour, the summation of shear forces on one side of centre of ram may differ from the forces on the other side. This results in the bending moment in the press ram as well as undesirable deflection and misalignment. It is therefore important to find out a point about which summation of shear forces will be symmetrical, called as centre of pressure.

Procedure

1. Draw the outline of actual cutting edges.
2. Choose X-X and Y-Y axis at convenient position. Make straight line, arc etc.
3. Devide the cutting edges into line elements such as straight, arc etc.
4. Find the length of elements such as \( l_1, l_2, \ldots, l_n \)
5. Find the centre of gravity of these lines about X-X and Y-Y axis
6. Find coordinates of centre of pressure \((X, Y)\)
   \[ X = \frac{l_1 x_1 + l_2 x_2 + \ldots + l_n x_n}{l_1 + l_2 + l_3 + \ldots + l_n} \]
   \[ Y = \frac{l_1 y_1 + l_2 y_2 + \ldots + l_n y_n}{l_1 + l_2 + l_3 + \ldots + l_n} \]
Problem 1: Locate the centre of pressure of the blank as shown in figure 1.

Problem 2: Locate the centre of pressure of the blank as shown in figure 2.