

PRESS FORMING OR SHEET METAL WORKING

Lecture by:

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- Types of presses
- Press Dies
- Press operations
 - Shearing
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Introduction press forming or sheet metal working

- Sheet metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bent into a variety of different shapes. thickness less than 6mm or large surface area to thickness ratio as flat, rectangular sheets of standard size.
- The first step in any sheet metal process is to cut the correct shape and sized blank from larger sheet. Die – punch combination is used for the process to impart the desired shape to the blank.
- Sheet metal processes can be broken down into two major classifications and one minor classification
 - SHEARING PROCESSES: processes which apply shearing forces to cut, fracture, or separate the material.
 - FORMING PROCESSES: processes which cause the metal to undergo desired shape changes without failure, excessive thinning, or cracking. This includes bending and stretching.
 - FINISHING PROCESSES: processes which are used to improve the final surface characteristics.

- ❖ Sheet metal forming involves predominantly tensile, shear or combination of forces and stretching or shrinking the sheet metal blanks.
- ❖ Hydraulic or mechanical presses are used for the forming process
- ❖ Die – punch combination is used for the process to impart the desired shape to the blank.
- ❖ Formability is the ability of sheet metal to undergo shape change without failure

Rolled Metal Thicknesses

- **Plates – thickness greater than 6 mm (1/4 inch);**
 - boiler supports (0.3 m, 12 inch)
 - reactor vessels (150 mm, 6 inch)
 - battleships and tanks (100-125 mm, 4-5 inch)
- **Sheets – less than 6 mm thick;** flat pieces, strips, and coils for beverage containers, automobile and aircraft bodies, appliances, kitchen and office equipment
 - Boeing 747 skin thickness – 1.8 mm (0.071 inch)
 - Lockheed L1011 skin thickness – 1.9 mm (0.075 inch)
 - Aluminum beverage cans – start as sheets that are 0.28 mm (0.011 inch) thick; later reduced to 0.1 mm (0.004 inch) by deep drawing
 - Aluminum foil – 0.008 mm (0.0003 inch)

Sheet Metals:

- Copper
- Various Steels
- Brass
- Alloys
- Aluminium

Products

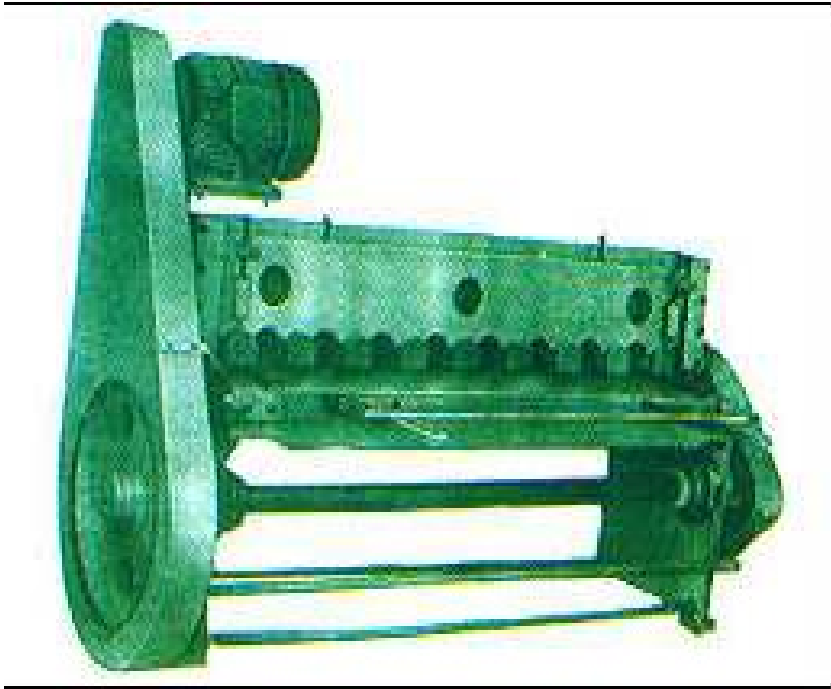
- Products include metal desks, file cabinets, appliances, car bodies, beverage cans, washers, kitchen sinks , aircraft panels etc.



Classification of presses

Classification on the basis of source of power.

- **Manual Presses:** These are either hand or foot operated through levers, screws or gears. A common press of this type is the arbor press used for assembly operations. Capacity $\frac{1}{2}$ to 10 tons
- **Mechanical presses:** These presses utilize flywheel energy which is transferred to the work piece by gears, cranks, eccentrics, or levers. 5 to 100 tons capacity
- **Hydraulic Presses:** These presses provide working force through the application of fluid pressure on a piston by means of pumps, valves, intensifiers, and accumulators. These presses have better performance and reliability than mechanical presses.
- **Pneumatic Presses:** These presses utilize air cylinders to exert the required force. These are generally smaller in size and capacity than hydraulic or mechanical presses, and therefore find use for light duty operations only.



Shearing machine (mechanical)



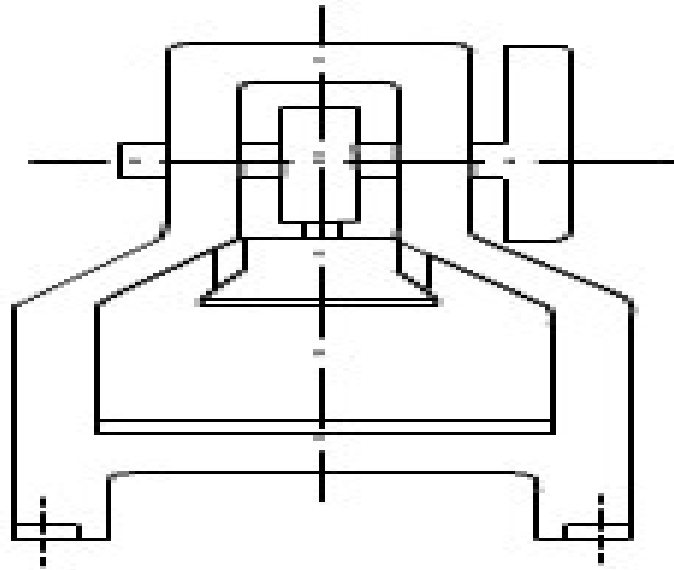
Hydraulic deep drawing press

Classification on the basis of number of slides

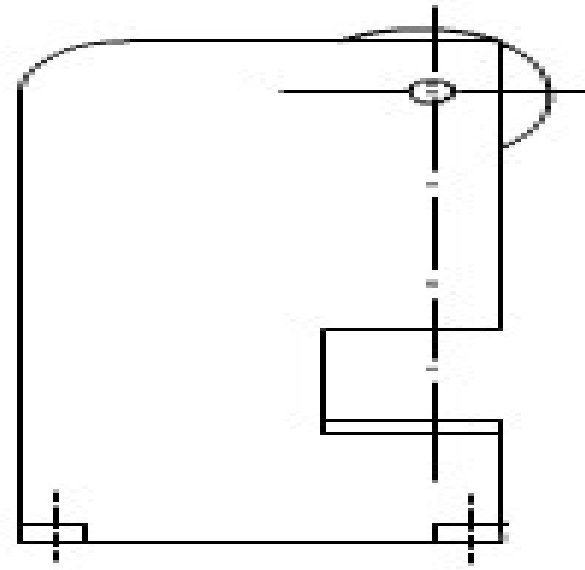
- **Single Action Presses:** A single action press has one reciprocation slide that carries the tool for the metal forming operation. The press has a fixed bed. It is the most widely used press for operations like blanking, coining, embossing, and drawing.
- **Double Action Presses:** A double action press has two slides moving in the same direction against a fixed bed. It is more suitable for drawing operations, especially deep drawing, than single action press.
- **Triple Action Presses:** A triple action press has three moving slides. Two slides (the blank holder and the inner slide) move in the same direction as in a double – action press and the third or lower slide moves upward through the fixed bed in a direction opposite to that of the other two slides. This action allows reverse – drawing, forming or bending operations against the inner slide while both upper actions are dwelling.

Classification on the basis of frame and construction.

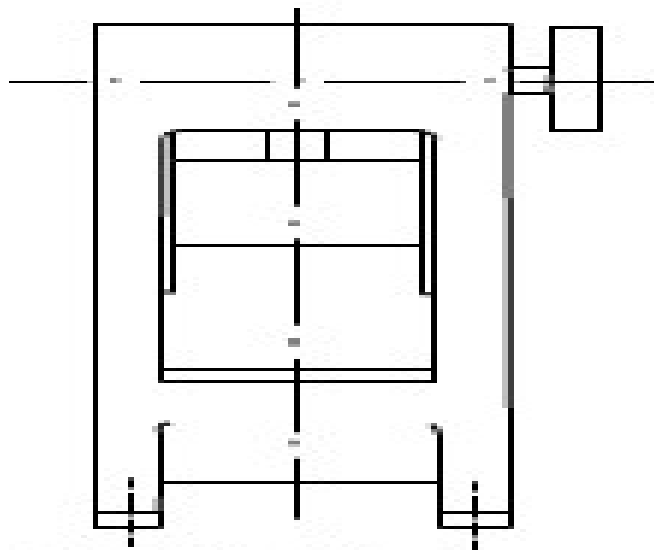
- **Arch – Frame Presses:** These presses have their frame in the shape of an arch. Double Action Presses
- **Gap Frame Presses.** These presses have a C-shaped frame. These are most versatile and common in use, as they provide un-obstructed access to the dies from three sides and their backs are usually open for the ejection of stampings and / or scrap.
- **Straight Side Presses.** These presses are stronger since the heavy loads can be taken in a vertical direction by the massive side frame and there is little tendency for the punch and die alignment to be affected by the strain. The capacity of these presses is usually greater than 10 MN.
- **Horn Presses.** These presses generally have a heavy shaft projecting from the machine frame instead of the usual bed. This press is used mainly on cylindrical parts involving punching, riveting, embossing, and flanging edges.



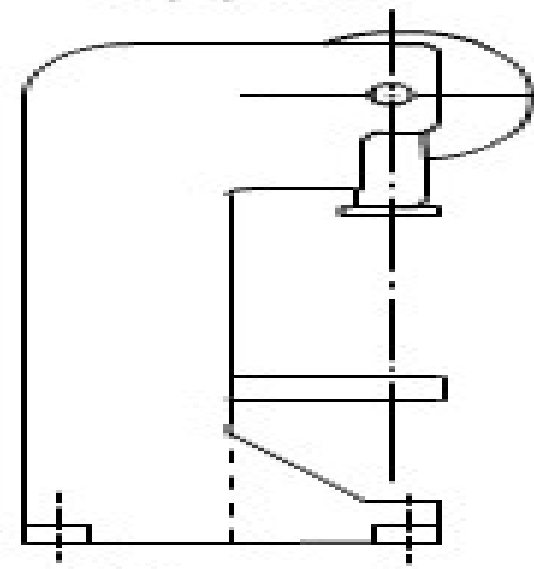
Arch press



Gap press



Straight side press



Horn press

Fig : Typical frame designs used for power presses

Q. Mechanical versus Hydraulic Presses

Mechanical presses are very widely used for blanking, forming and drawing operations required to be done on sheet metal. For certain operations which require very high force, for example, hydraulic presses are more advantageous.

Characteristic	Mechanical Presses	Hydraulic Presses
Force	Depends upon slide position.	Does not depend upon slide position. Relatively constant.
Stroke length	Short strokes	Long strokes, even as much as 3 m.
Slide speed	High. Highest at mid-stroke. Can be variable	Slow. Rapid advance and retraction. Variable speeds uniform throughout stroke.
Capacity	About 50 MN (maximum)	About 500 MN, or even more.
Control	Full stroke generally required before reversal.	Adjustable, slide reversal possible from any position.
Application	Operations requiring maximum pressure near bottom of stroke. Cutting operations (blanking, shearing, piercing), Forming and drawing to depths of about 100 mm.	Operations requiring steady pressure through-out stroke. Deep drawing. Drawing irregular shaped parts. Straightening. Operations requiring variable forces and /or strokes.

Press Dies

- Basic tools used with a metalworking press are the punch and the die.
- Punch: A convex tool for making holes by shearing , or making surface or displacing metal with a hammer.
- Die: A concave die, which is the female part as opposed to punch which is the male part.
- Die materials: High alloy steels heat treated for the punches and dies.

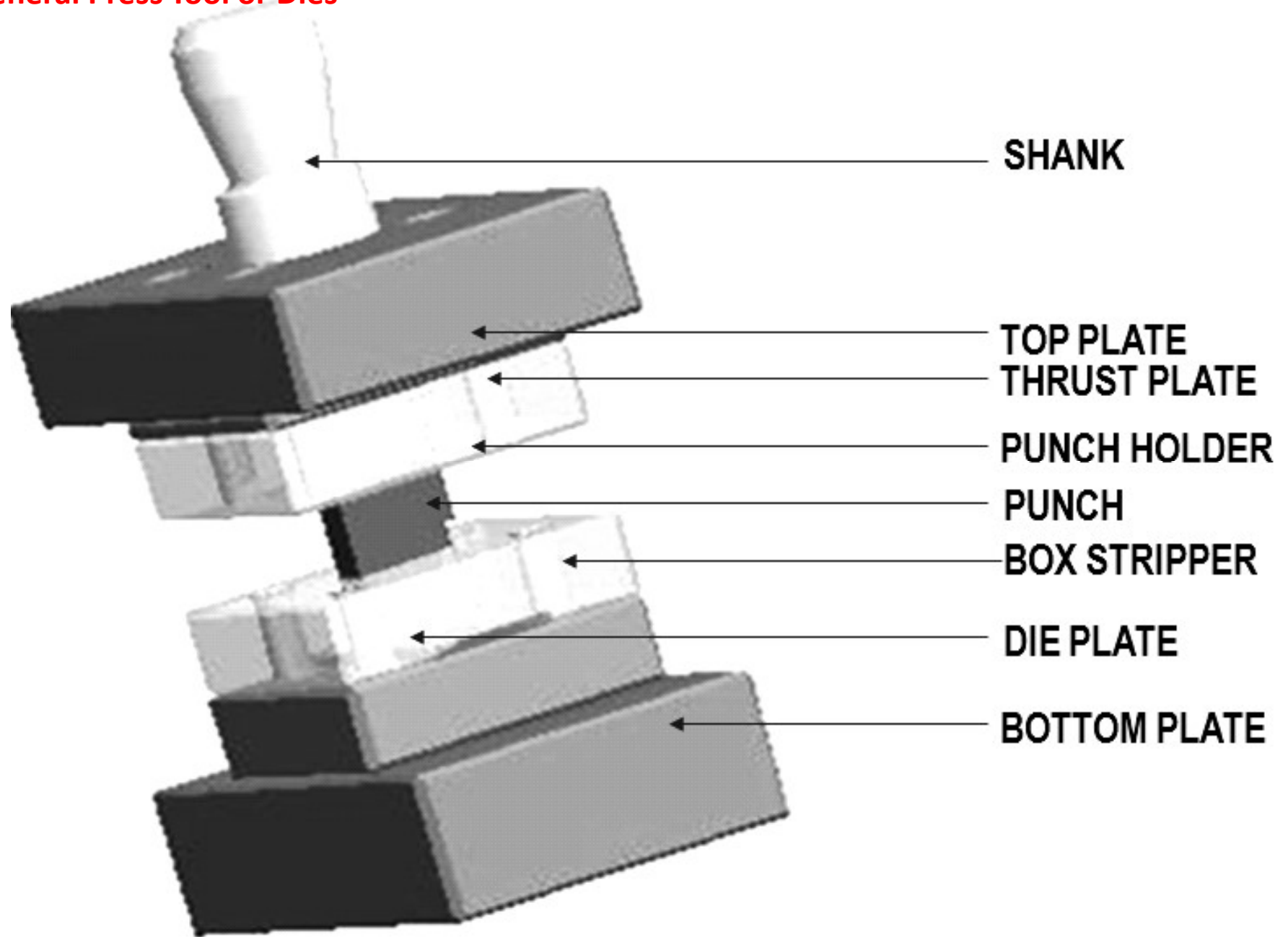
A die set is composed of

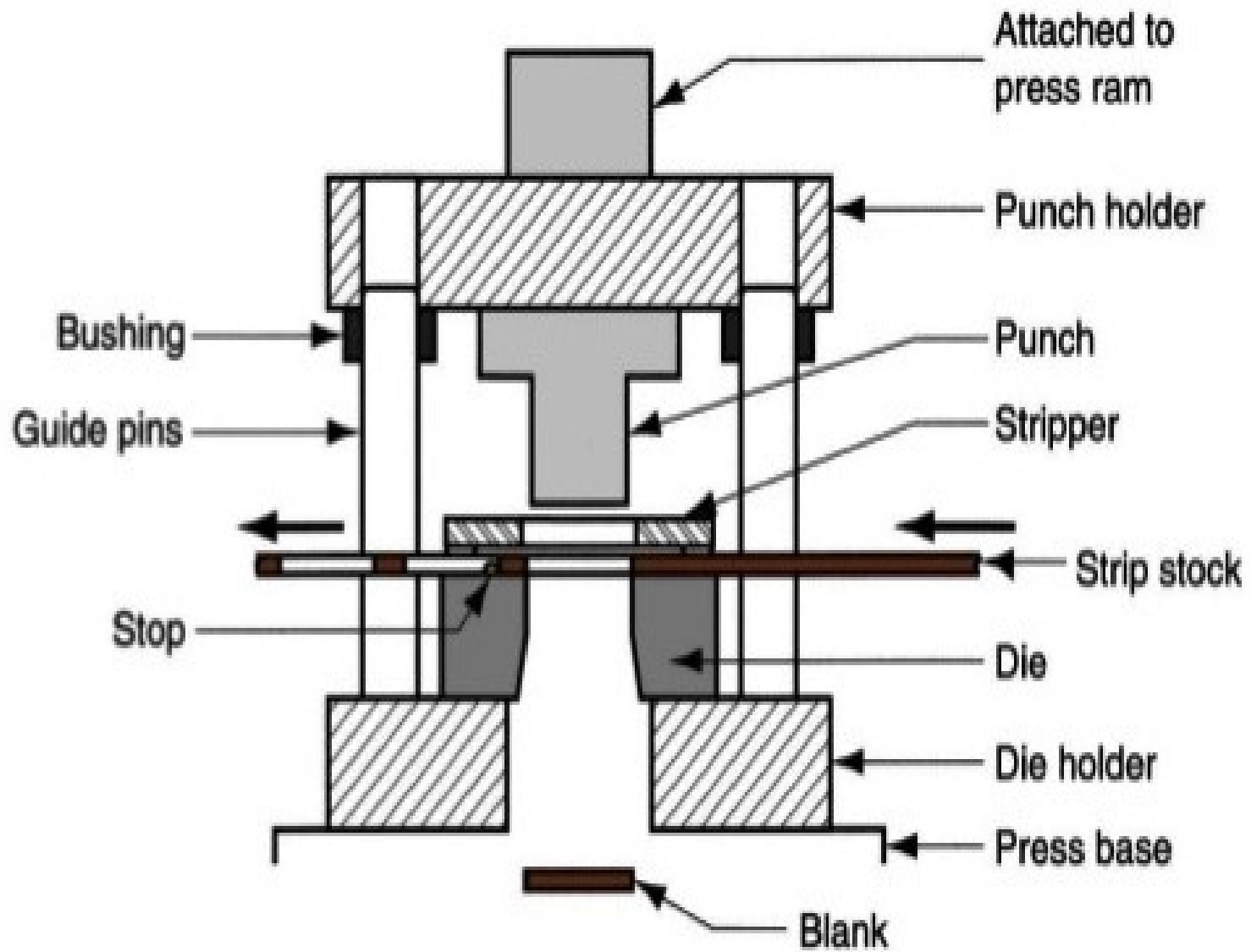
- 1) Punch holder which holds punch plate connected with blanking and piecing punches for cutting the metal sheet.
- 2) Die block consists of die holder and die plate which was designed to give the desired shape of the product.
- 3) Pilot is used to align metal sheet at the correct position before blanking at each step.
- 4) Stripper plate used for a) alignment of punch and die blocks b) navigate the punch into the die using harden stripper inserts and c) remove the cut piece from the punch

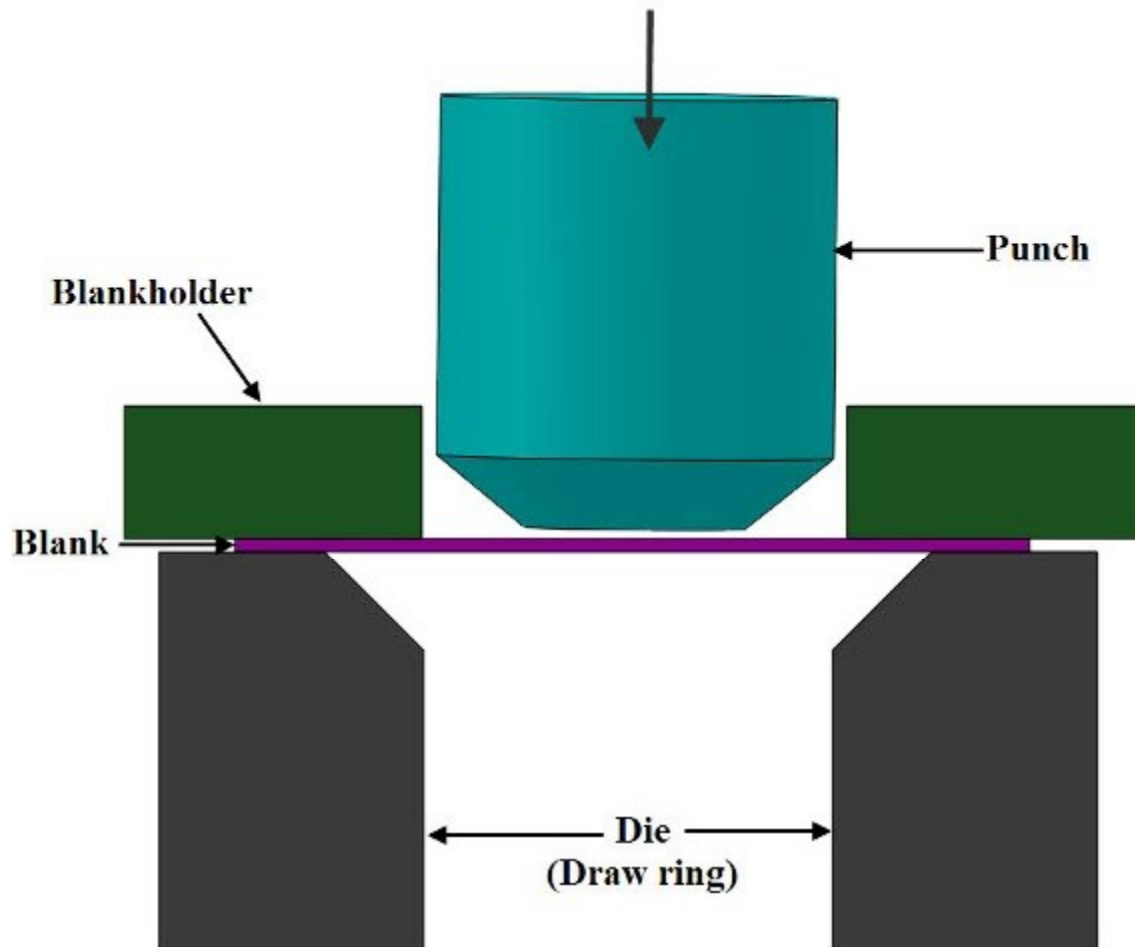
General press tool construction elements:

- **Shank** : It is used to locate the press tool in press for alignment purpose.
- **Top Plate**: It is used to hold top half of the press tool with press slide.
- **Punch Back Plate** : This plate prevents the hardened punches penetrating into top plate.
- **Punch Holder**: This plate is used to accommodate the punches of press tool.
- **Punches** : To perform cutting and non cutting operations either plain or profiled punches are used.
- **Die Plate**: Die plate will have similar profile of the component where cutting dies usually have holes with land and angular clearance and non cutting dies will have profiles.
- **Die Back Plate**: This plate prevents the hardened Die inserts penetrating into bottom plate.
- **Guide Pillar & Guide Bush** : Used for alignment between top and bottom halves of the press tools.
- **Bottom plate**: It is used to hold bottom half of the press tool with press slide.
- **Stripper plate**: it is used to strip off the component from punches.
- **strip guides**: It is used to guide the strip into the press tool to perform the operation.

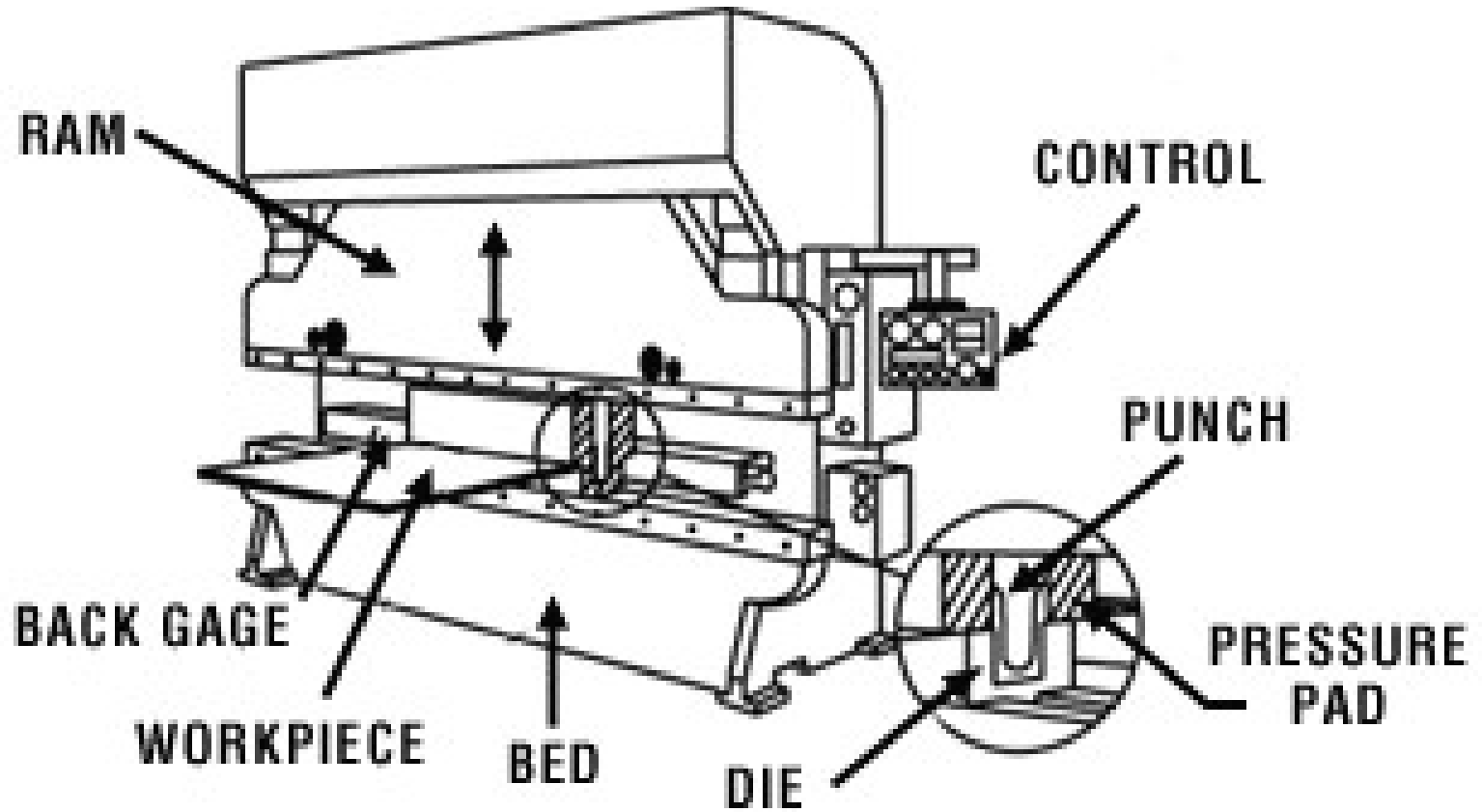
General Press Tool or Dies







A single action press with a very long narrow bed



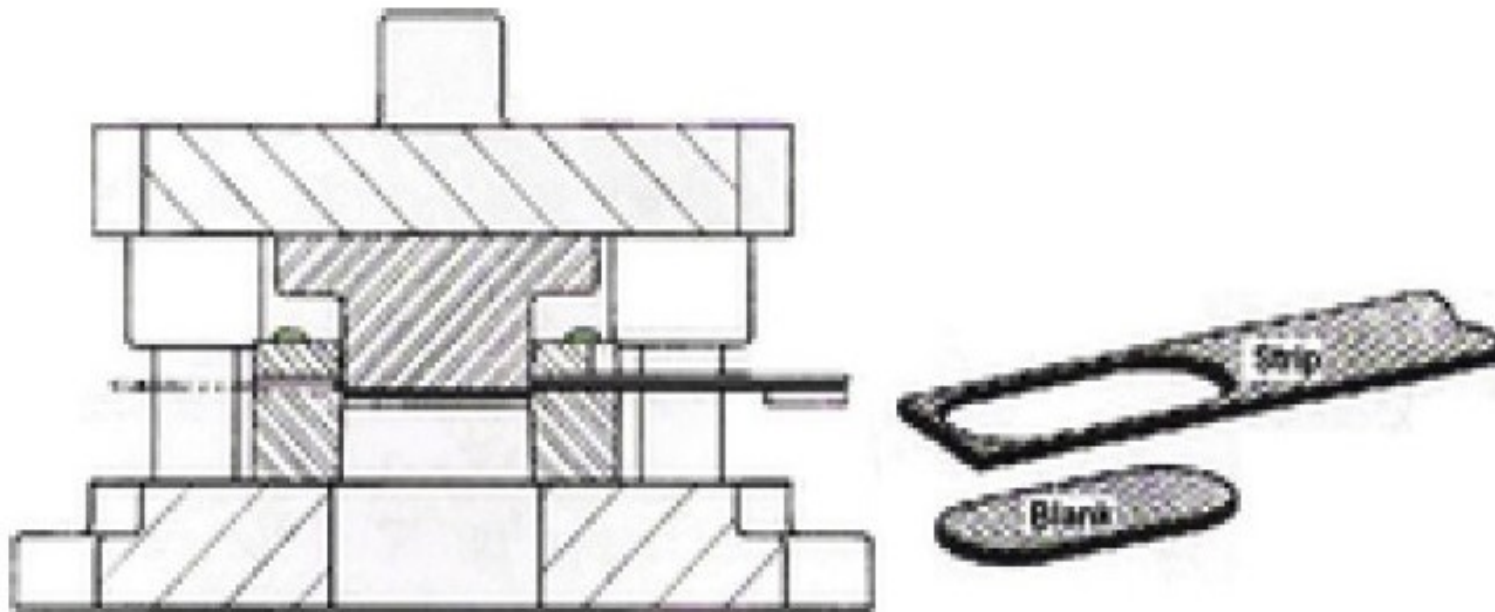
PRESS BRAKE MACHINE

Type of Dies

- Press tools or dies are commonly used in hydraulic, pneumatic, and mechanical presses to produce components at high volumes. Generally press tools are categorized by the types of operation performed using the press tool or die, such as blanking, piercing, bending, forming, forging, trimming etc.
1. Blanking die :
 2. Piercing die
 3. Trimming die
 4. Bending die
 5. Forming die
 6. Drawing die
 7. Progressive die
 8. Compound die
 9. Combination die

blanking tool or die

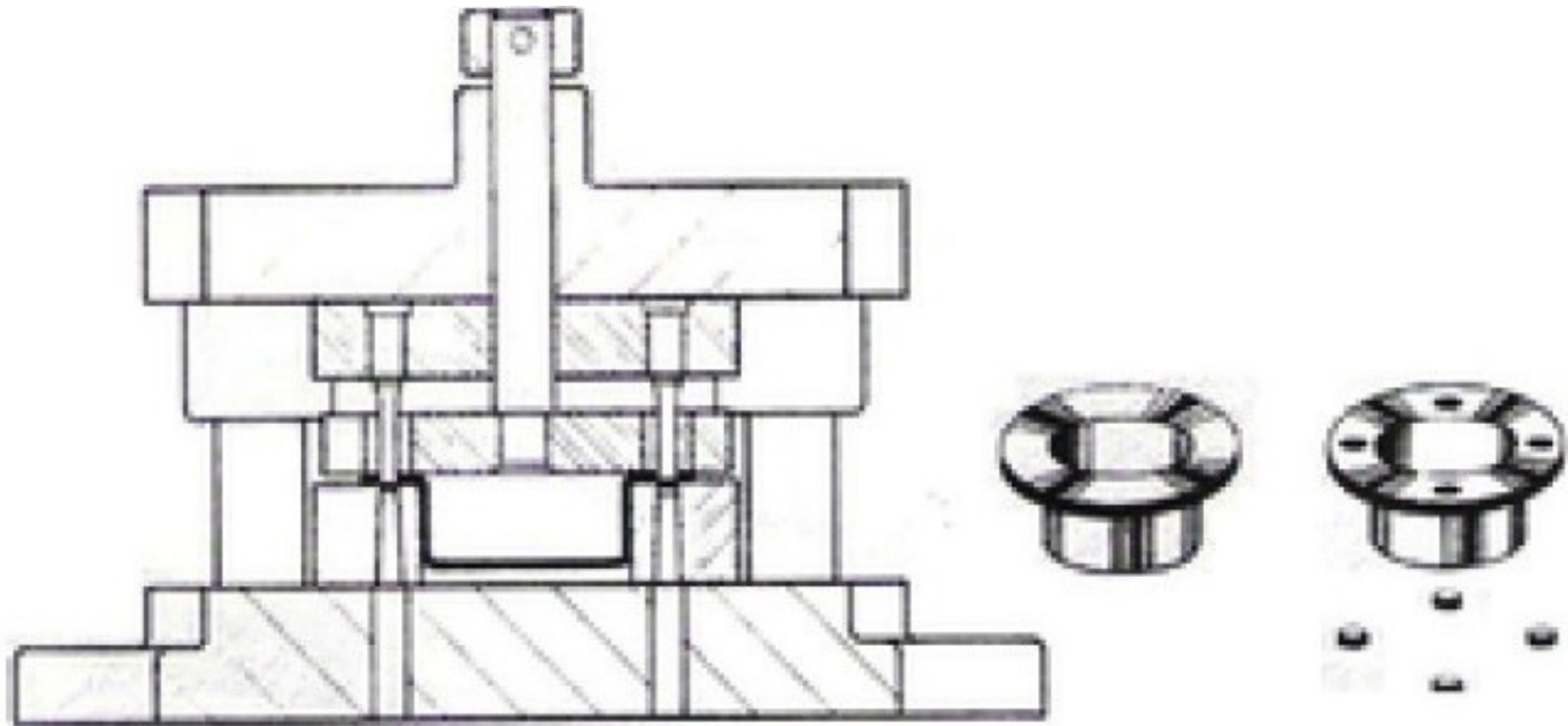
When a component is produced with one single punch and die where the entire outer profile is cut in a single stroke the tool is called a blanking tool or die.



Blanking Tool

Piercing die

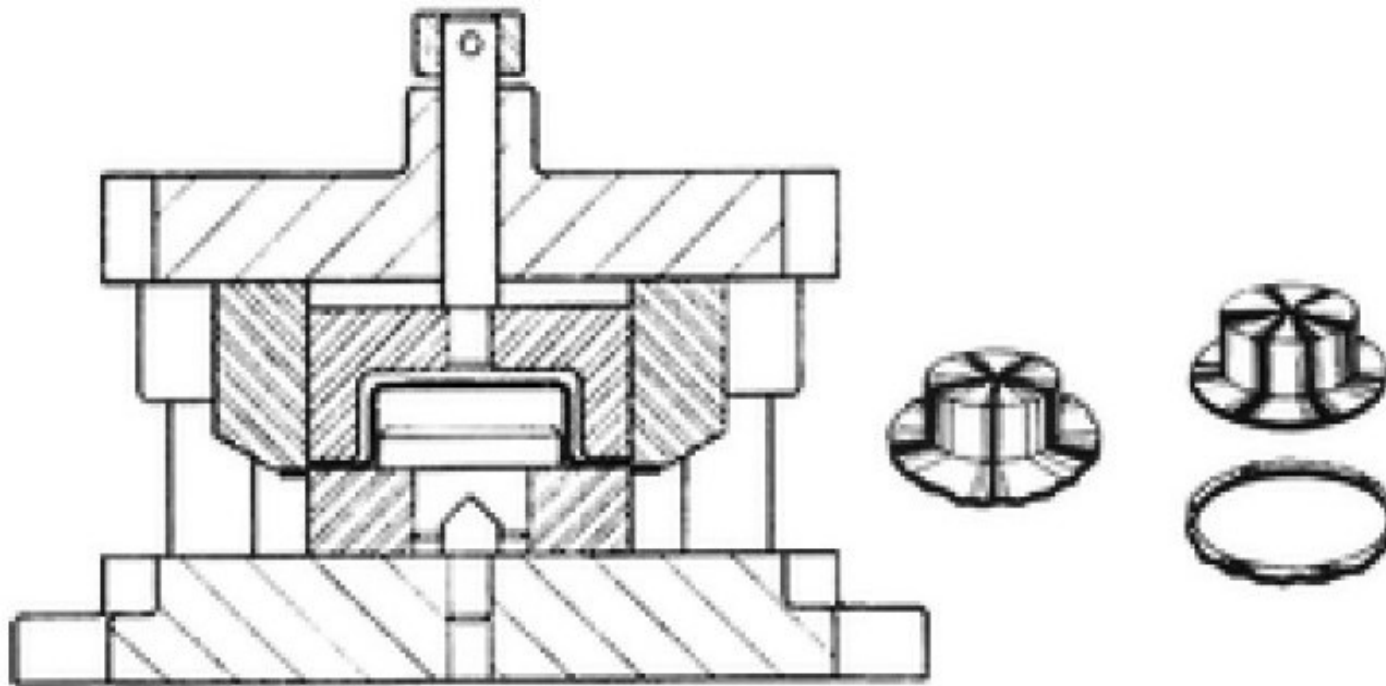
- Piercing involves cutting of clean holes with a resulting scrap slug.



Piercing tool

Trimming die

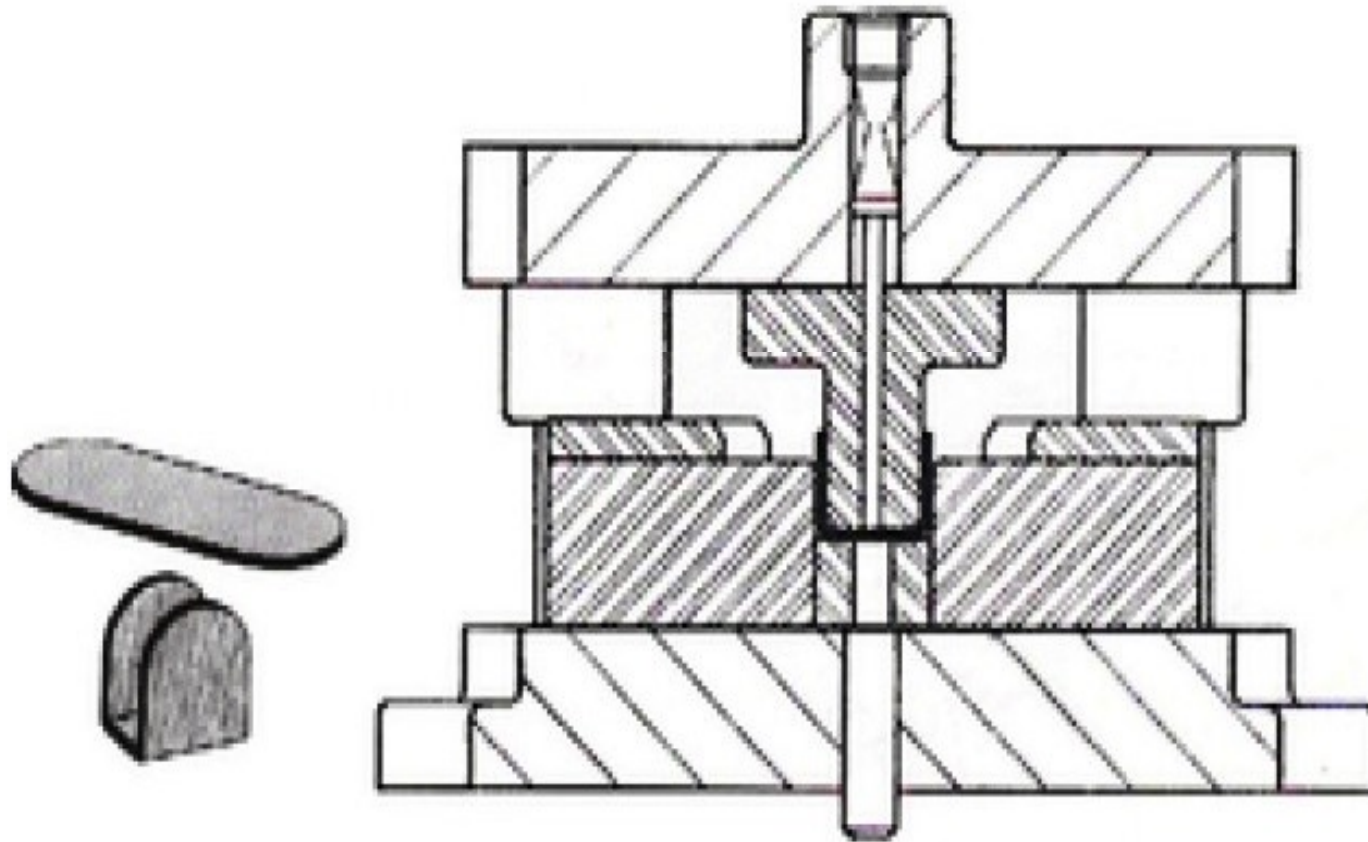
- When cups and shells are drawn from flat sheet metal the edge is left wavy and irregular, due to uneven flow of metal. While a small amount of Material is removed from the side of a component in trimming tool



Trimming Tool

Bending die

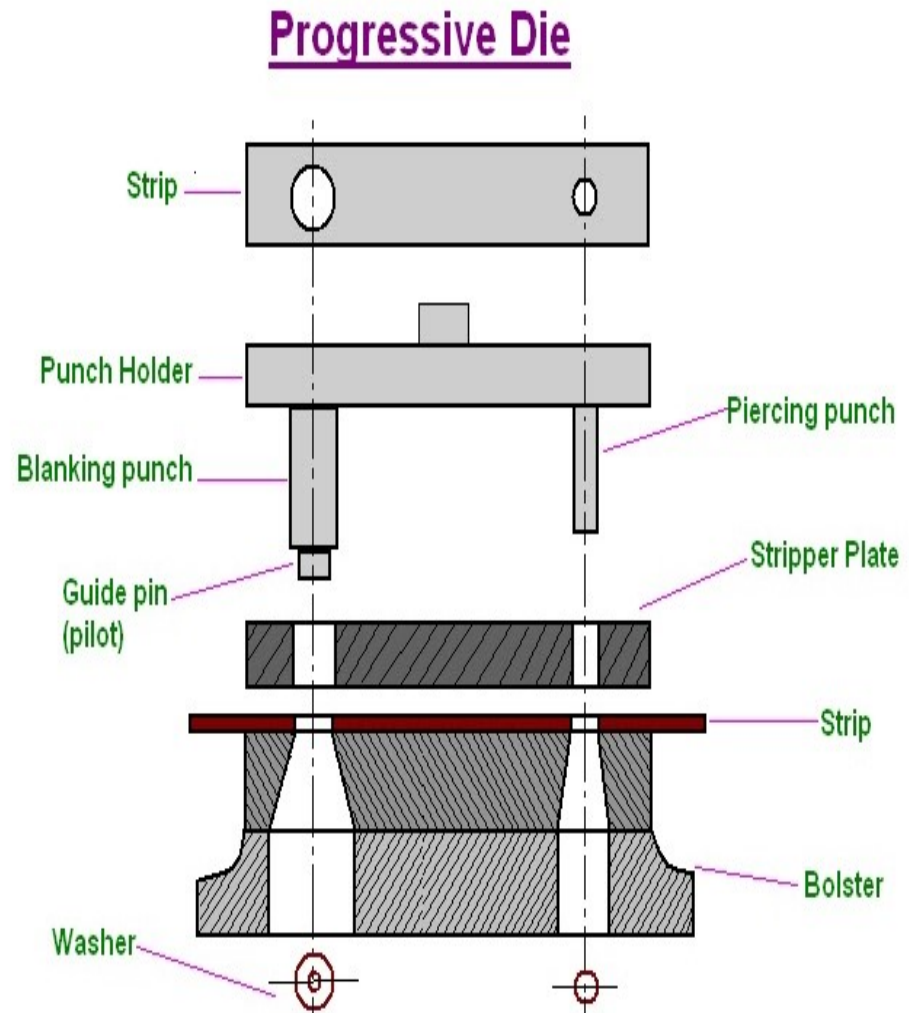
- Bending tools apply simple bends to stampings



Bending Tool

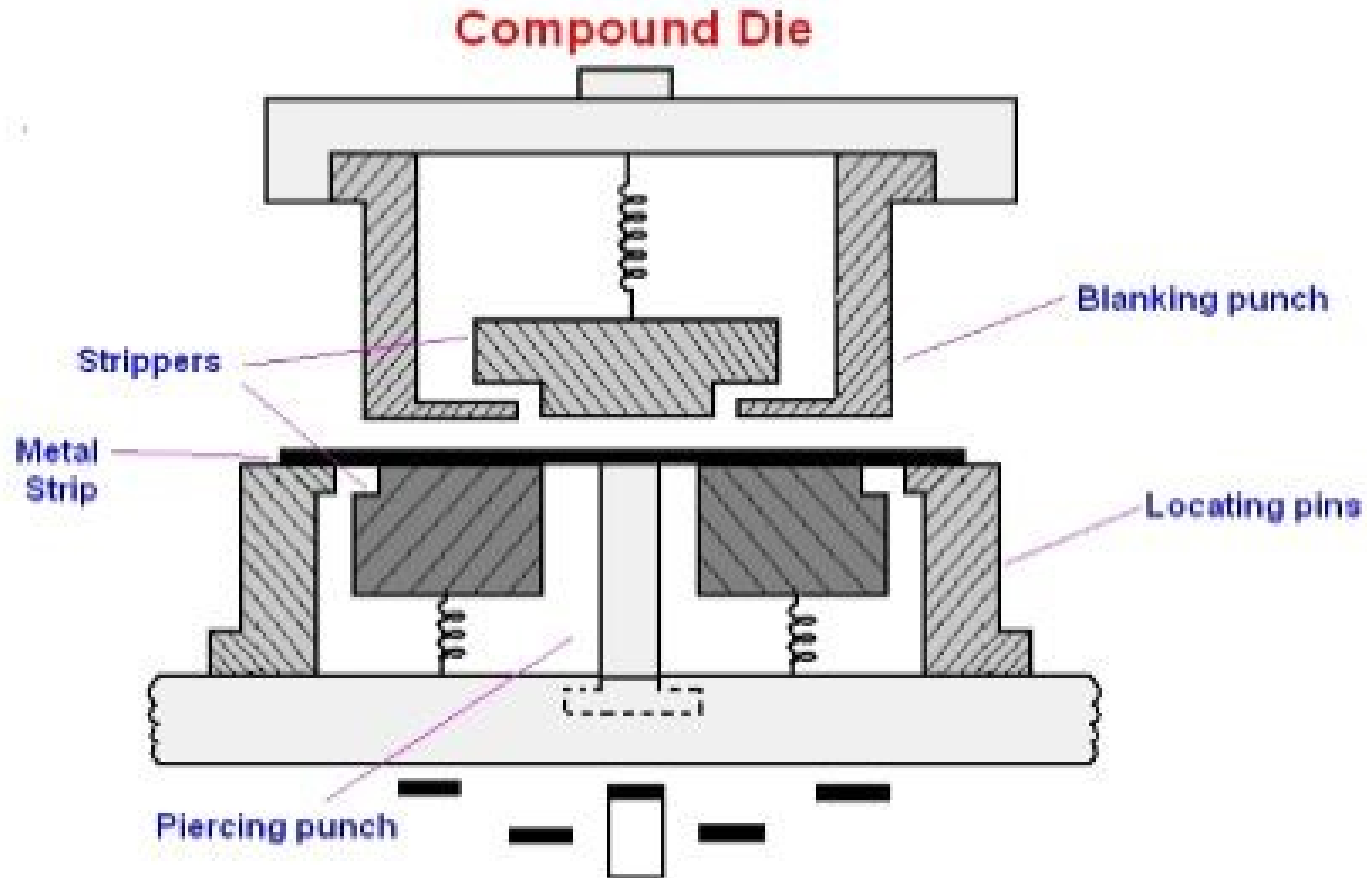
Progressive die

- In a progressive die the final component is obtained by progressing the sheet metal or strip in more than one stage. At each stage the tool will progressively shape the component towards its final shape, with the final stage normally being cutting-off.

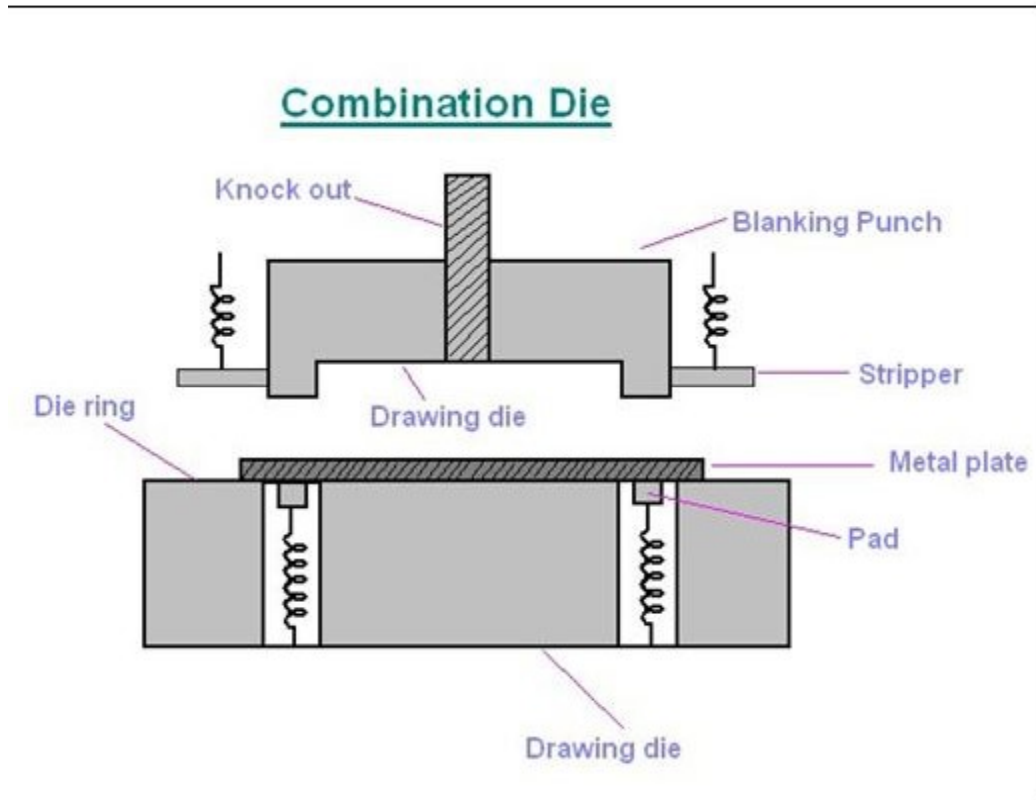


Compound Die

- The compound Die differs from progressive die by the arrangement of the punch and die. It is an inverted tool where blanking and piercing takes place in a single stage



Combination Die



- ▶ In this die also , more than one operation may be performed at one station.
- ▶ It is different from compound die in that in this die, a cutting operation is combined with a bending or drawing operation, due to that it is called combination die.

Combination die

- In a combination die two or more operations will be performed simultaneously. Two or more operations such as bending, drawing, extruding, may be combined on the component with various cutting operations like blanking, piercing, and cut off takes place. it can perform a cutting and non cutting operations in a single die.