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Program : **B.Tech**

Subject Name: **Manufacturing Process**

Subject Code: **ME-305**

Semester: **3rd**

Press Working:

Press working may be defined as, a manufacturing process by which various components are made from sheet metal. This process is also termed as cold stamping. The machine used for press working is called a press.

The main features of a press are:

- A frame that supports a plunger or a slide and a bed, a source of mechanism for operating the piston in the line with the bed in a normal manner.
- The plunger is provided with appropriate punches / perforations and a die block is attached to the bed.
- A form is produced by the plunger drop when the punch moves in and into the die block.
- The punch and die assembly is generally referred to as a "die" or as a "die set".

Press working operations:

The sheet metal operations done a press may be grouped into two categories.

1: Cutting operations

2: Forming operations

In cutting operations the work piece is stressed by its ultimate strength. The stresses caused in the metal the applied forces will be shear stresses. The cutting operations include:

(a) Blanking (b) Punching (c) Notching

(d) Perforating (e) Trimming (f) Shaving

(g) Slitting (h) Lancing

In forming operations, the stresses are below the ultimate strength of the metal, in this operation, there is no cutting of the metal but only the contour of the work piece is changed to get the desired product.

The forming operations include:

(a) Bending (b) Drawing (c) Squeezing

Shearing

Shearing is a sheet metal cutting operation along a straight line between two cut-ting edges by means of a power shear.

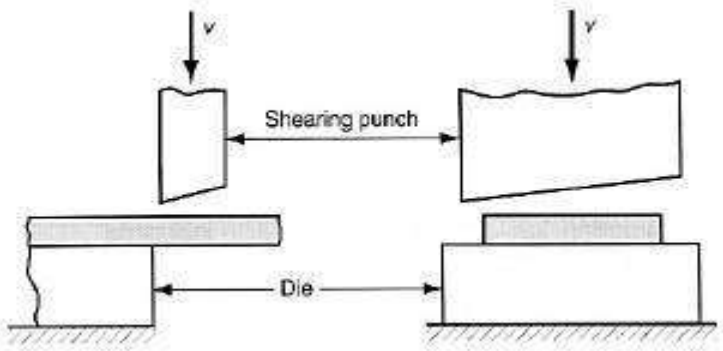


Figure 4.1- Shearing

Blanking and punching

Blanking and punching are similar cutting operations that involve cutting the sheet metal along a closed profile. If the piece to be cut is the desired product, the operation is called ***blanking*** and the product is called empty. If the remaining part is the desired part, the operation is called ***punching***. Both operations are illustrated in the example of the production of a washer.

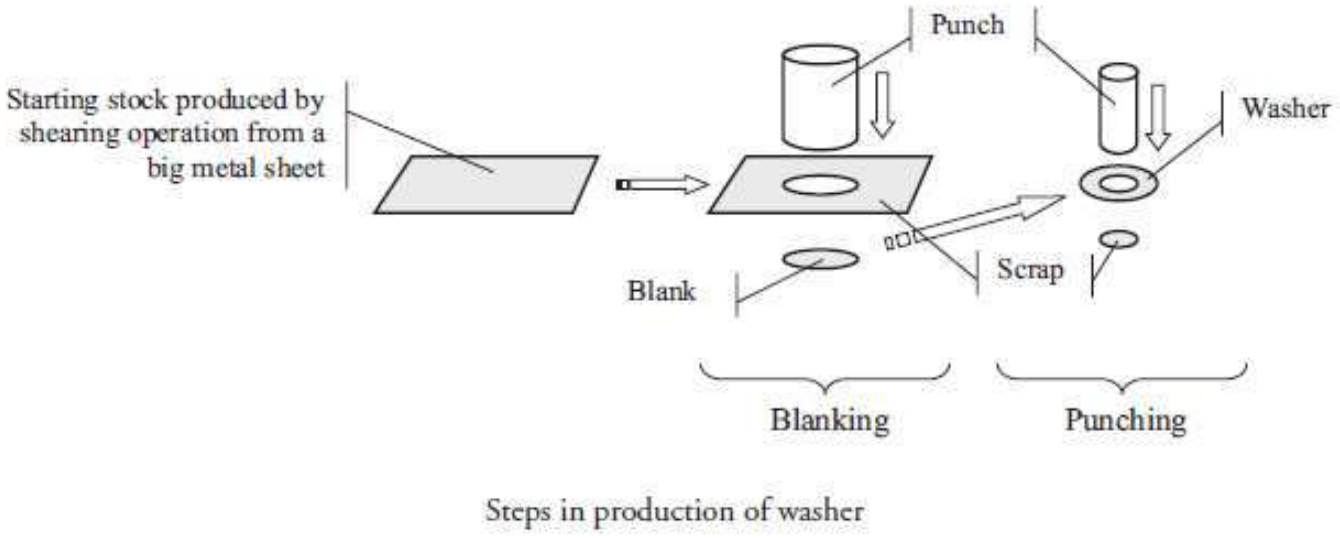


Figure-4.2 Steps in Production of Washer

Bending

Bending is defined as the straining of the sheet metal around a straight edge

Bending deforms a flat sheet along a straight line to form the required angle. The various sections, such as corners, channels, etc., are formed by bending, which can then be used for the manufacture of steel structures.

Three common folding methods are shown in Fig.

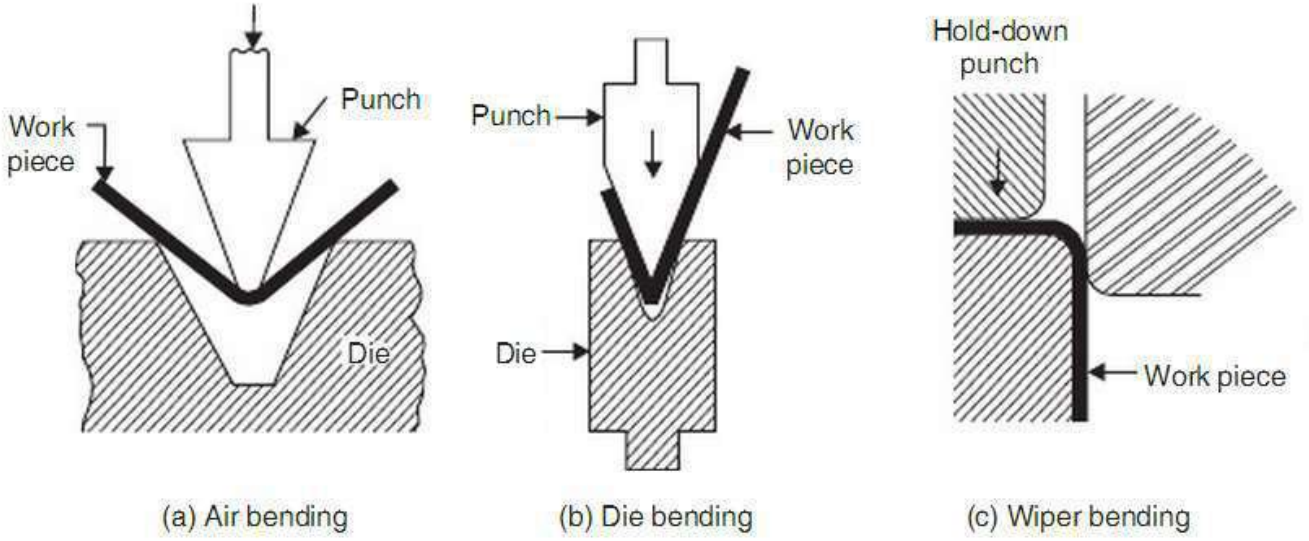
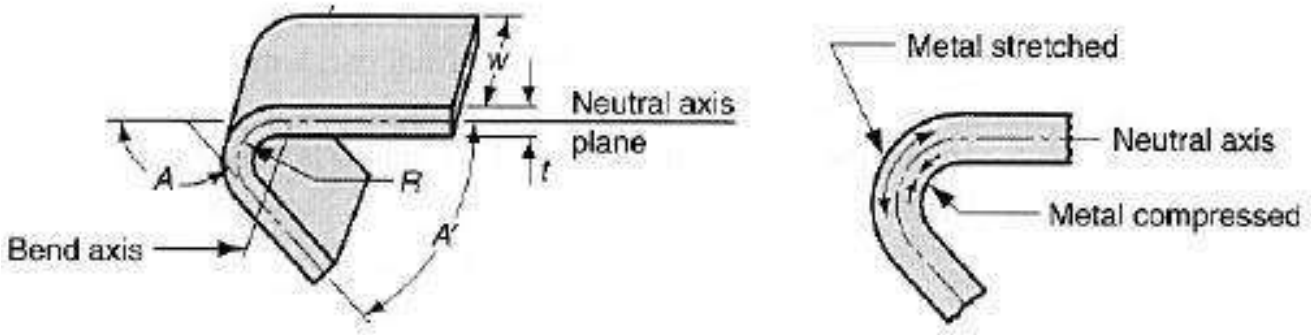


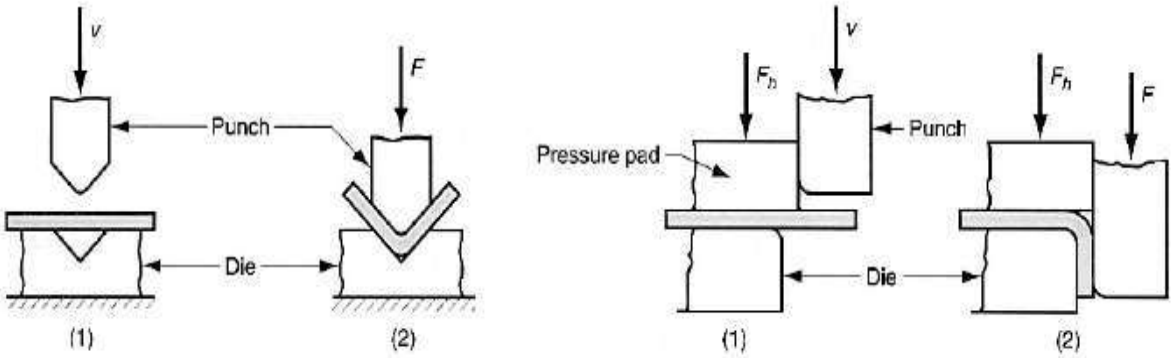
Figure-4.3 Folding Methods



Bending of sheet metal

Figure-4.3 Sheet Metal Bending

Bending operations involve the processes of *V-bending* and *edge bending*:



(*Left*) V-bending, and (*Right*) edge bending; (1) before and (2) after bending

- *V-bending*—sheet metal is bent along a straight line between a V-shape punch and die.
- *Edge bending*—bending of the cantilever part of the sheet around the die edge.

Figure-4.4 V-bending & Edge bending

Other Bending Operation

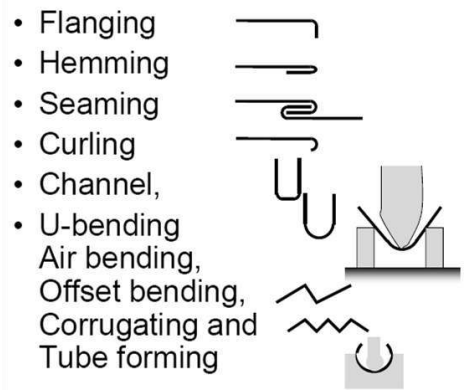


Figure-4.5 Bending Operations

Spring back - the elastic recovery of the material after unloading of the tools

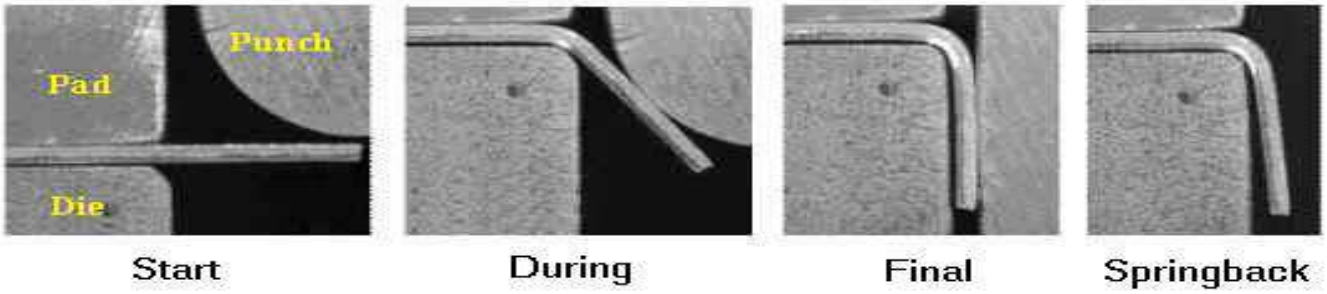


Figure-4.6 Demonstration of Spring back

To compensate with the unbending action of the spring back, the metal should be slightly over bent.

NOTCHING: A shearing operation that removes a portion from the outer edge of a metal strip or part.

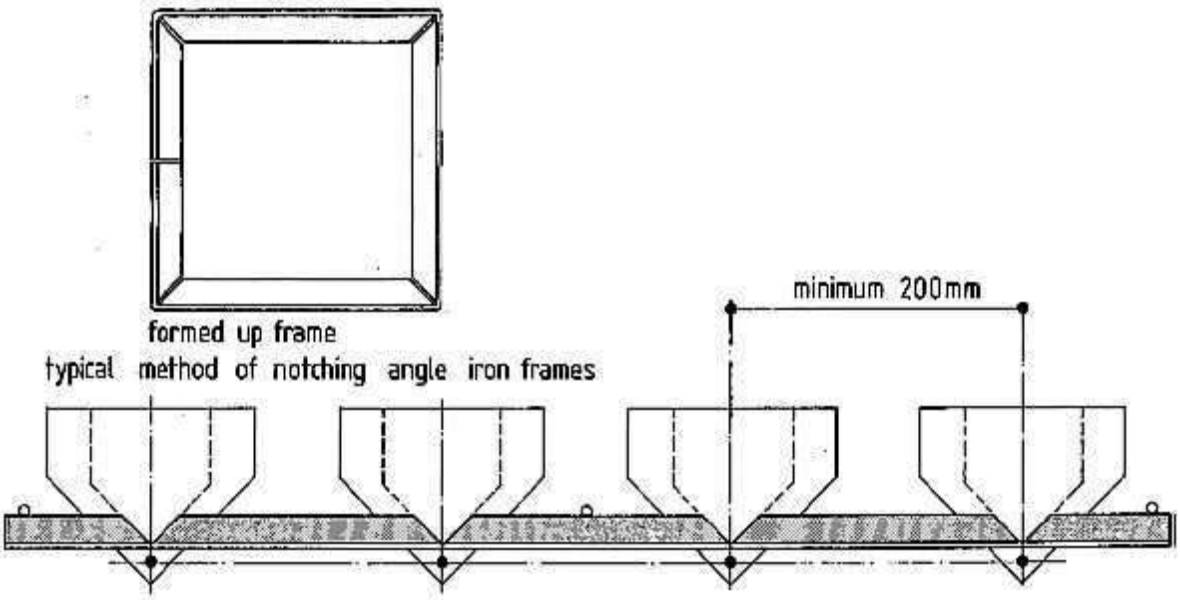


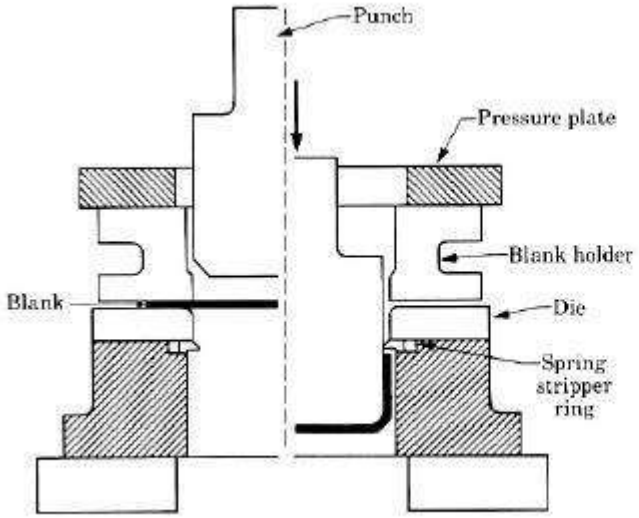
Figure-4.7 Notching Operation

BENDING

Bending deforms a flat sheet along a straight line to form the required angle. Various sections, such as corners, channels, etc., are formed by bending, which can then be used for the manufacture of steel structures. Three common bening methods are shown in Fig.

Drawing

Drawing is a sheet-metal operation to make hollow-shaped parts from a sheet blank



Deep drawing of a cup-shaped part: (*Left*) start of the operation before punch contacts blank, and (*Right*) end of stroke

Figure-4.8 Deep Drawing Machine

DEEP DRAWING In deep drawing process, we start with a flat metal plate or sheet and convert it into cup shape by pressing the sheet in the center with a circular punch fitting into a cup shaped die. In household kitchen, we use many vessels like deep saucepans (or BHAGONA), which are made by deep drawing process. If the depth of cup is more than half its diameter, the process is termed as deep drawing and with a lesser depth to diameter ratio, it is called shallow drawing. Parts of various geometries and shape are made by drawing process. The deep drawing process is illustrated in Fig.

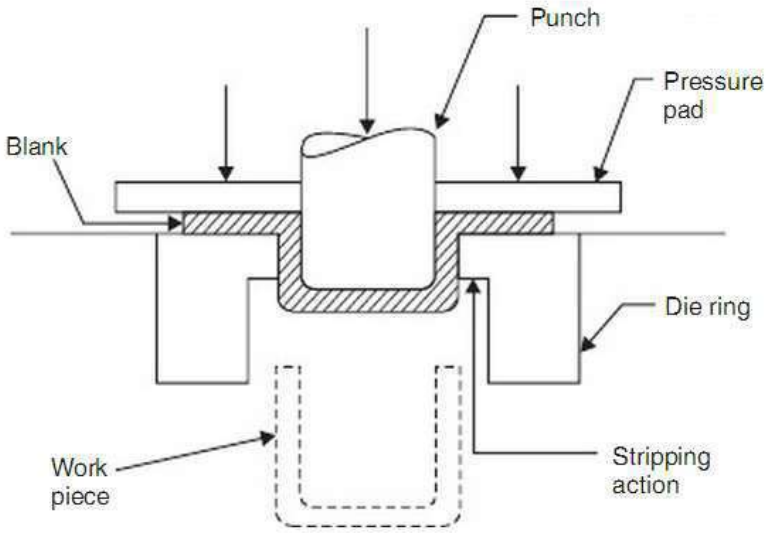


Figure-4.9 Deep Drawing Process

COINING AND EMBOSSING

Both coining and embossing operations are done 'cold' and mechanical presses with punch and die are used for these operations.

In **embossing**, impressions are made on sheet metal so that the thickness of the sheet remains uniform throughout, even after embossing has been performed. It means that if one side of the sheet is raised to form a drawing, there is a further depression on the other side of the sheet. It is basically an urgent task in which there is no need for much strength. The sheet extends on the lower mold and the punch stroke is

adjusted so that when moved to its lowest position, it leaves a uniform spacing between the impressions sculpted in the punch and the mold equal to the thickness of the sheet being embossed. The drawing is transferred to the sheet by bending the plate up or down without altering its thickness in any way. Many pieces of decoration with religious motifs are made in this way.

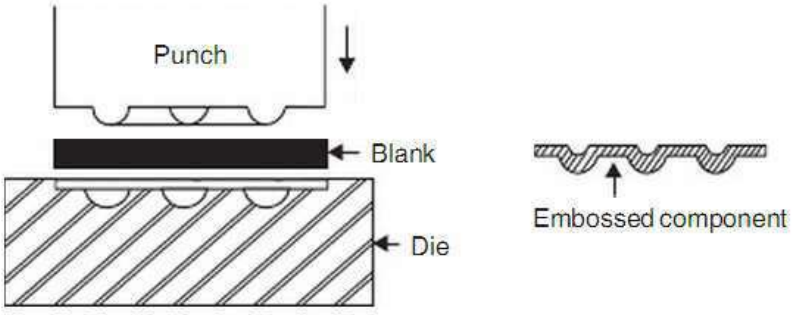


Figure-4.10 Embossing Operation

In **coining** process, a piece of metal that is softened by an annealing process is placed between two molds that contain an impression. The blank is constrained in its circumference so that the two dies that are closed so that the material cannot flow sideways. The material can only flow upwards (thus filling the depressions in the upper die) and down (when filling the depressions in the lower die). The result of the cutting operation is that the engraved design on the upper and lower molds is printed on the corresponding faces of the embossed material (eg. the raised material) without changing the thickness of the circumference of the thickness. Coins used as money in everyday use are produced in this way. Here the forces required are much higher, enough to cause a plastic-flow of material. The molding and conveying processes are shown in Fig.

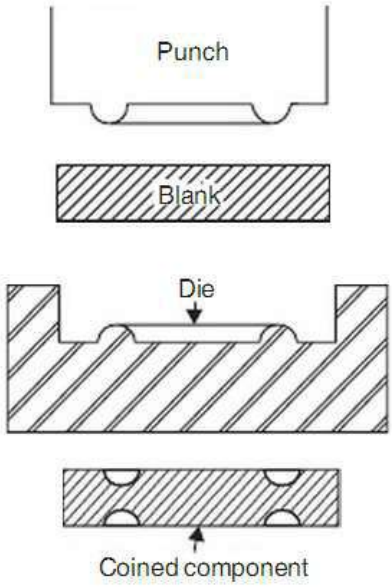


Figure-4.11 Coining Operation

The main features of a press are:

- A frame that supports a plunger or a slide and a bed, a source of mechanism for operating the piston in the line with the bed in a normal manner.

- The ram/plunger is provided with appropriate punches / perforations and a die block is attached to the bed.
- A form is produced by the plunger drop when the punch moves in and into the die block.
- The punch and die assembly is generally referred to as a "die" or as a "die set".

These presses are available in two configurations:

(i) Open frame type, and

(ii) Closed frame type.

- Open frame type presses are less robust as compared to closed frame type, but provide greater access for loading material as they are open in front as well as sides. Due to their appearance, they are also referred to as C-frame or gap presses as well.
- Closed frame type presses are used for heavier work. The capacity of the press is indicated by the force (or tonnage), the press is capable of exerting.

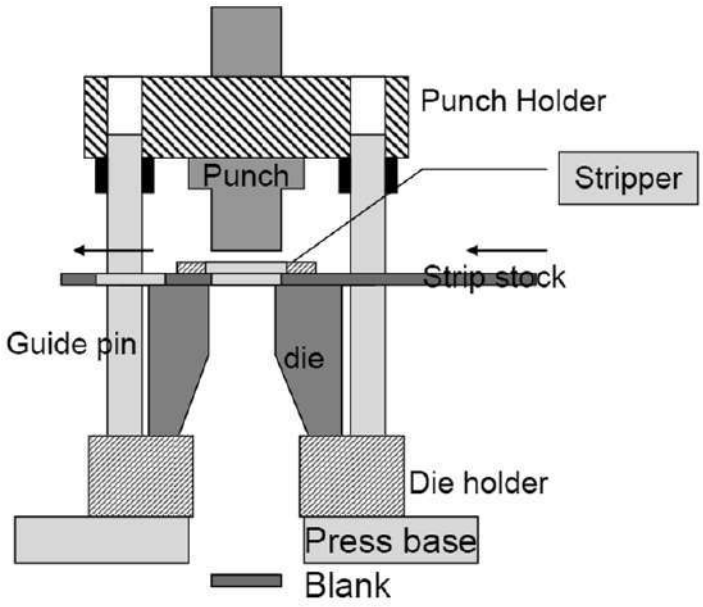


Figure 4.12- Press

Fundamentals of Press Operation

The force with which the pressure ram is able to exert safely is called tonnage of the press. The press slides exert a greater force than the rated tonnage due to the built-in safety factor. The tonnage of hydraulic press is equal to the product of the piston area and oil pressure in cylinder. The tonnage is varied by changing the oil pressure. The tonnage of the mechanism is equal to the size of the crankshaft or eccentric shaft bearings. Mecca tonnage is used to illustrate the product of the crankshaft material crankshaft and the crankshaft bearing area. Mechanical tonnage is maximum when the slide is near the bottom of its stroke.

Stroke

Reciprocating motion of a press slide is called the stroke. Stroke is expressed in mm between terminal points of the motion. The stroke is constant for mechanical press while it is adjustable for hydraulic press.

Shut Height

The distance from the top of the bed to the bottom of the slide with the stroke down and the adjustment up is called shut height.

Die Space

Die space is the area available for mounting dies in the press.

Press Working Terminology

A simple cutting die is shown in Figure

Bed

The bed is lower part of press frame that serves as a table on which a bolster plate is mounted.

Bolster Plate

Bolster plate is a thick plate secured to the press bed, which is used for locating and supporting the die assembly. Its thickness is usually 5 to 12.5 cm.

Die Set

Die set is unit assembly which incorporates a lower and upper shoe, two or more guide posts and guide post bushings.

Die

Die is the female part of a complete tool for producing work in a press. It is also referred to a complete tool consisting of pair of mating members for producing work in press.

Die Block

It is the block or a plate which contains the die cavity.

Lower Shoe

The lower shoe of a die set is generally mounted on the upper plate of a press. The die block is mounted on the lower shoe. The guide posts are also mounted in it.

Punch

Punch is the male component of the die assembly which is directly or indirectly moved by or fastened to the press ram or slide.

Upper Shoe

It is the upper part of the die set which contain die post bushings.

Punch Plate

The punch plate or punch retainer fits closely over the body of the punch and holds it in proper relative position.

Back Up Plate

It is also called pressure plate. It is placed so that the intensity of pressure does not become excessive on punch holder. The plate distributes the pressure over a wide area and intensity of pressure on the punch holder is reduced to avoid crushing.

Stripper

Stripper is a plate which is used to strip the metal strip from a cutting or non-cutting punch or die. It may also guide the strip.

Knock Out

Knock out mechanism is used to remove the work piece from a die. It is connected to and operated by the press ram.

Pitman

Pitman is a connecting rod which is used to transmit the motion from the main drive shaft to the press slide.

Types of Die

Dies are classified according to the type of press operation and according to the method of operation.

According to the type of the press operation, dies are classified as cutting dies and forming dies.

Cutting Dies

Cutting dies are used to cut the metal. They use cutting and shearing action for cutting the metal. Examples of cutting dies are blanking dies, piercing dies, perforating dies, notching dies, trimming dies, shaving dies and nibbling dies, etc.

Forming Dies

Forming dies change the shape of the blank without removing any stock. Example of forming dies are drawing dies, bending dies and squeezing dies.

According to the method of operation, dies are classified as simple dies, compound dies, combination dies, progressive dies, transfer dies and steel rule dies, etc.

Progressive Die

It is also called a follow on die. The progressive die is shown in Figure. It performs two or more operations in one stroke of a ram at different stages. First operation is punching, which is followed by blanking. The metal strip is transferred to the next station in between the stroke to produce a complete work piece.

When the piercing punch cuts a hole in the strip, the blanking punch draws out a portion of the metal strip in which a hole had been pierced at a previous station. The metal strip is fed into the die mechanically or manually. The primary stop is pushed in by hand and lead end is then made to contact with it. The press is now made to operate to pierce a hole at station 1. As the primary stop is released, the strip is transferred to the station 2. The strip contacts with automatic button die stop at station 2.

During the next stroke, the pilot on blanking punch enters the previously pierced hole which ensures the exact alignment of the strip to be blanked next. The die stop activation pin pushes the die stop pin below the edge of the blank. Hence the strip is transferred to next station on return stroke of the ram. The button die stop pin returns to its normal position and holds the strip on the inside wall of the blanked hole. During the third stroke, another complete part is produced and thereafter parts are produced at each stroke of the ram. In a progressive die, force required is reduced to a large extent due to the staggering of punches. The disadvantage of progressive die is that it makes balancing of the punches difficult.

Combination Dies

In a combination die, cutting action is combined with non-cutting actions, i.e. forming. Non-cutting actions may be bending, drawing, extrusion or embossing. More than one operation is possible in one stroke at a single stage, but the die is more useful for two operations only. The principle of working of a combination dies is shown in Figure.

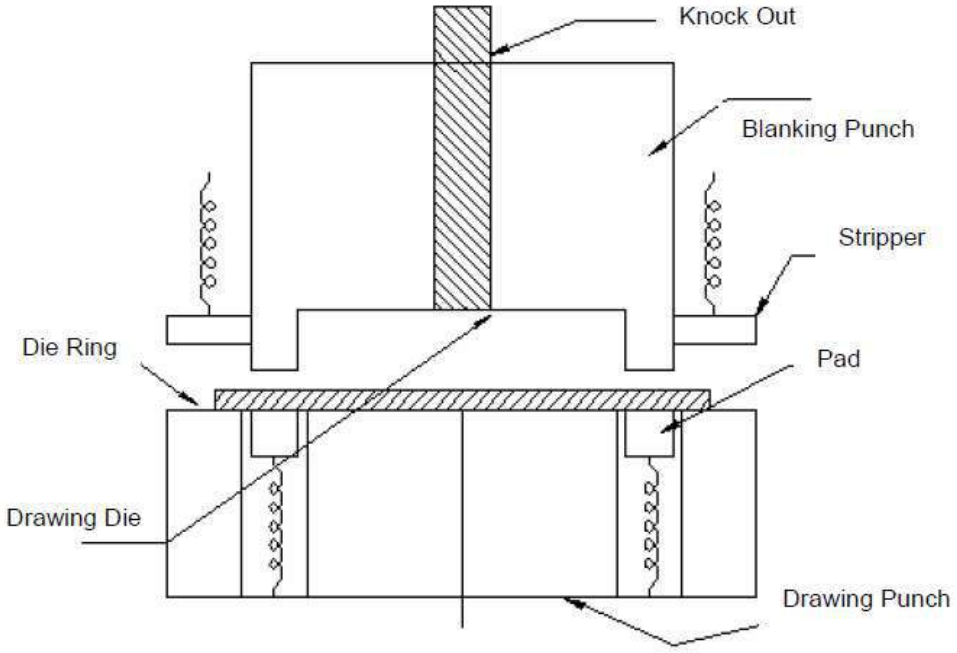


Figure 4.13- Combination Dies

Press room accessories include: hydraulic shock dampers, stock/scrap cutters, die lights, shock/vibration mounts, rotary limit switches (cam switches), and stock nibblers.

These help to reduce press damage and press repair cost, better handle scrap and recapture scrap material value, improve die setup, and optimize press operation.

Hydraulic shock dampers to prevent/control press snap through shock loads; thereby, reducing expensive press repair and downtime.

Rapid-Air stock cutters/choppers for cutting coil stock and skeleton stock at the end of a progressive die or similar process. Our flat or round stock cutters can also be integrated into a complete cut to length line or integrated with existing equipment to complete a cut to length or cut off operation.

Die lights are ideal for increasing visibility at the point of operation to assist in setup, trouble shooting, and die maintenance. The die lights are available in a variety of sizes and optional magnetic mounts. They are easily located in place and are shock and lubricant tolerant.

Vibro/Dynamics shock, vibration, and leveling mounts are designed for power presses and similar machines. Leveling the press prevents stressing the frame and other drive components. This reduces maintenance, increases press life, and often results in improved part quality. The shock mounts also reduce the amount of shock and noise transmitted to surrounding areas and structures.

Electro mechanical adjustable rotary limit switches (cam switches) are used to precisely time/energize electrical devices to a machine stroke or cycle. When used with power presses the rotary limit switch (RLS) may be used to set press control timing such as automatic upstroke timing or top stop position; feed advance/pilot release timing, control part blow off, and in die lubrication timing.

Press Coil Stock Feeding Devices

Many years ago, the majority of blanks were fed into presses by hand. Some simple progressive dies are hand fed with stock sheared from rectangular rolled sheet stock if production volume is not high. Many older press working methods were somewhat dangerous.

Types of Feeders

Press feeders are available in many different configurations depending upon the application. However, most feeders fall into two main classifications, which are:

1. Roll feeders, which advance the stock into the die by a pair of power driven rolls. The feeder may be powered directly by the press crankshaft or a motorized drive system.

2. Hitch or grip feeders, which advance the stock into the die by mechanically gripping the stock and advancing it the required amount. These also may be directly actuated by the press ram, Crankshaft or separately powered. The most common power source is compressed air.

Terms related to Press Working-

Auxiliary equipment

Presses are typically used with **auxiliary equipment** such as coil stations, strengtheners, transfer systems, stackers/de-stackers and slug/chip conveyors.

1. mechanical roller feeders
2. electronic feeder with clamps
3. feed and straightening units
4. motorized strengtheners
5. un-coilers

Safety devices

Safeguarding Devices are engineering controls or safety attachments that stop normal press operations if the operator's hands are inadvertently within the point-of-operation. Methods of controlling access to point-of-operation hazards include but are not limited to the following:

1. **Presence-sensing Safety Devices** This prevents the initiation of a press cycle (stroke) or stops the cycling (stroking) of the press during the closing portion if the operator's hands are in the point-of-operation
2. **Two-hand Control Devices** Two-hand control devices require the use of both hands of the operator to press operating controls. These devices shall locate the controls at a distance from the point-of-operation such that the slide completes the closing portion of the cycle (stroke), or stops before the operator can reach the point-of-operation
3. **Movable Barrier Device** A movable barrier device, when used, shall enclose the point-of-operation before a press cycle (stroke) can be initiated. • Movable barrier devices are usually used on presses which require access to the point-of operation once per cycle (stroke). • The device shall prevent the operator from reaching the point-of-operation hazards by reaching over, under, around or through the device when in the closed position.

Stock feeders

Feed devices for piercing or blanking operations In automatic piercing and blanking, the operation is carried out from a metal strip. There are two strip feed systems: the roll feed and the gripper feed system.

1. **Roll feed system**

This consists of two pairs of rollers which move the stock by friction. The movement is derived from the eccentric shaft as a link drive.

2. **Gripper feed system**

This is a feed system where the strip stock being moved is clamped between two pairs of gripper jaws. Here, the movement itself, as shown in Figure 28.3, can again be derived from a link drive, but there are also hydraulic and pneumatic drives.

Die Design Fundamentals

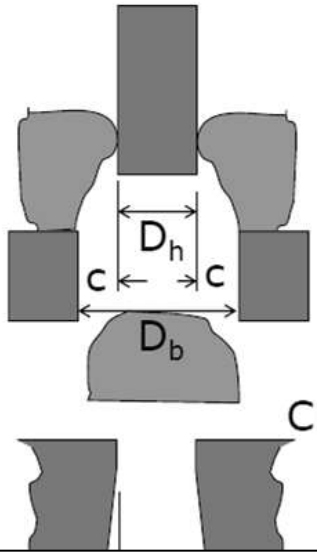


Figure 4.14- Die Nomenclatures

Blank punch diameter =Db-2c
Blank die diameter = Db

Hole punch diameter =Dh
Hole die diameter = Dh+2c

Angular clearance of 0.25oto 1.5o

Cutting forces: *F*

*=S*t*L=0.7*TS*t*L*

Where, S= Shear strength

t=thickness

L=length of cutting edge

TS =Ultimate tensile strength

RATING OF A PRESS

A press is classified in tons of force that can be applied to the chute without undue tension and without compromising the structural strength of the press. The tonnage of a mechanical press is determined by the size of the crankshaft or eccentric bearings. It is given by the relation:

Tonnage capacity = cutting force of the crankshaft material * crankshaft area

The tonnage capacity of a mechanical press is always given when the slide is near the bottom of the stroke, because it will be maximum at the point or with the crank turned for an angle not greater than 30 degree from the zero bottom position. The tonnage capacity of a hydraulic press is given by:

Tonnage capacity = piston area * oil pressure in the cylinder

As previously known, the capacity of a hydraulic press can be varied by changing the oil pressure. In double acting crank presses, the internal diaphragm tonnage determines the maximum traction pressure, while the maximum sealing pressure in white depends on the tonnage of the outer sledge. To maintain tension and deformation of the press structure, it is common practice to choose a press from 50% to 100% above the force required for an operation. In the case of single, double and triple hydraulic presses, the uprights can be driven by a pumped hydraulic pump or by single transmission from one or more pumps.

REQUIREMENTs OF A PRESS TOOL DESIGN

1) Dimensional precision and surface finish of the stampings must confirm the design and the specific action.
2) The work pieces of the printing machine (die or punch) must be sufficiently strong, durable and easily replaceable when worn.
3) The die must guarantee the required time output, easy maintenance, safe operation and reliable attachment to the press.
4) The die must be designed in such a way that, as far as possible, standard components for its manufacture are used. Minimum special pieces should be used as you possibly can in your design.

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