# MODEL ANSWER

## SUMMER– 18 EXAMINATION

**Subject Title: Advance Fabrication Process** Subject Code: 17622

**Important Instructions to examiners:**

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

| Q. NO. | Sub Q.no | MODEL ANSWER | MARKS |
|---|---|---|---|
| **1** | **A** | **Attempt any three:** | **3*4** |
| | a | Comparison of flame cutting and shearing:<br>-Multiplicity of components in a wide range of sizes and thicknesses can be shaped by oxygen cutting i.e one oxygen cutting machine can replace several mechanical types of cutting machines.<br>-Guillotines are of limited capacity with regard to the thickness of material to be cut and used for straight line cutting only.<br>-Oxygen-cutting is difficult for material upto 3mm thickness, because of difficulty to produce a clean flame cut edge below this thickness. The preheat flame tends to melt the top edges of the cut causing them to fuse together. Hence, stack cutting method is recommended,<br>-Oxygen-cutting is faster than sawing and can cut greater thicknesses than the shearing machines.<br>-Bevel-edge cutting is no problem for oxygen cutting process compared to shearing machines that produce only square cut edges.<br>-Portable and static nibbling machines are used along with a profile template, but can produce one component at a time. Flame profile cutting machines are capable of producing number of components from a template simultaneously. | **4m** |

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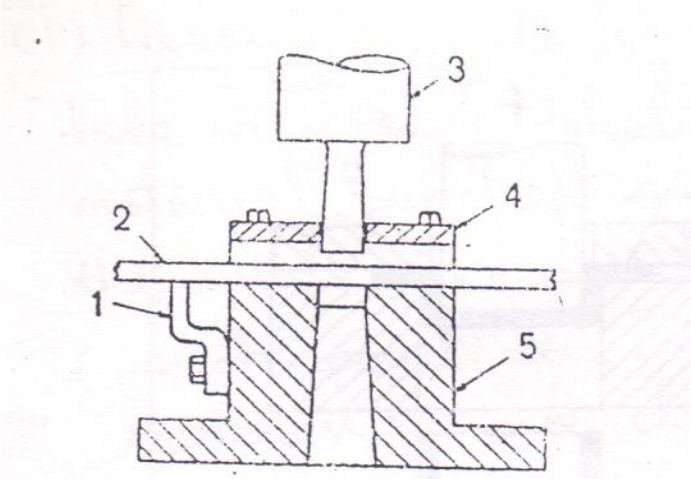
| | | | |
|---|---|---|---|
| | b | The difference between 'folding' and 'bending' is so slight that they are both carried out with the same purpose in view which is to deflect the metal from one flat plane to another so that it stays there permanently.<br>If the deflection is sharp and the radius small, the metal is said to be folded .e.g. a single fold or hem.<br>Should the curvature be large and the deflection cover a large area, it is called bending .e.g. the rolling of a hollow body, such as a cylinder.<br>Folding or bending involves the deformation of a material along a straight line in two dimensions only. | 4m |
| | c | Blanking: It is the operation of cutting of flat sheet to the desired shape. The metal punched out is the required product and the plate with the hole left on the die goes as waste. The die governs the size of the blank produced and clearance is left on the punch.<br>  <br><br>Fig. Q. . Punch and die set up for piercing, punching and blanking<br>1. *Stop*, 2. *Plate*, 3. *Punch*, 4. *Stripper plate*, 5. *die*.<br><br>Piercing: It is the operation of production of a hole in a sheet metal by the punch and die. The material punched out to form the hole constitutes the waste. The punch governs the size of the hole (punch point diameter is less than or equal to material thickness) and clearance is provided on die. | 2m<br><br>2m |

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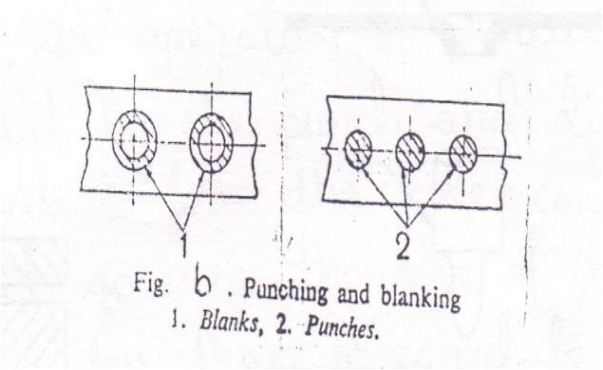
| | |  Fig. b . Punching and blanking<br>1. *Blanks*, 2. *Punches.* | |
| | d | Advantages of power hack sawing:<br><br>• A major advantage is the relatively low capital investment required.<br>• Easy to set up and simple to operate.<br>• Unskilled or semi-skilled help can be used and one operator can often attend two or more machines.<br>• Tooling costs are low and the blades are inexpensive enough to make it economically feasible to throw them away when they become worn.<br>• Tendency for the blades to twist or deflect is minimal.<br>• Maintenance costs are low because of the simple design and operation.<br>• Versatility is another important advantage. The machines can handle most cutting requirements including practically all materials, a wide range of stock sizes within their capacities and any cut-off length.<br>• Accuracies maintained and finishes produced range from fair to good depending on the material being sawed.<br><br>Disadvantages of power hack sawing:<br><br>• A major disadvantage is that the machine is slow.<br>• The cutting action is non continuous, and only half of each reciprocating stroke is productive.<br>• The reciprocating action of hack sawing prohibits the use of blade supports close to the area of cutting. This may cause bowing of the blade and some inaccuracy. Therefore blades are made thicker, thus requiring more power and producing more chips.<br>• Power hack sawing is essentially a roughing operation and at least 0.05mm should be left on cut surfaces for finishing.<br>• Blade wear is uneven because only part of the blade is used for cutting since the arm holding the blade obstructs the use of blade ends.<br>• The necessity for stopping and reversing the direction of blade travel at the end of each stroke causes the cutting speed to vary, thus reducing efficiency. | 2m<br><br>(any 2 advantages)<br><br>2m<br><br>(any 2 disadvantages) |

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| | | | |
|---|---|---|---|
| | **B** | **Attempt any One:** | **1*6** |
| | a | **i)** Factors influencing the quality of cut:<br>The success of the flame cutting operation depends upon;<br>• Selecting the correct size of cutter nozzle for the thickness of the material being cut.<br>• Operating the cutting torch at the correct oxygen pressure.<br>• Moving the cutting torch at the correct cutting speed.<br>• Maintaining the nozzle at the correct distance from the plate surface.<br>(If the torch is adjusted and manipulated correctly, a smooth narrow cut, termed the 'kerf', is produced).<br><br>**ii)** Flame lighting:<br>The procedure used for lighting a welding torch is adopted when lighting a cutting torch, but with some difference. The fuel gas regulator is set to the correct working pressure in the normal way and the oxygen regulator is set to the correct working pressure with the cutting oxygen valve on the torch in the open position.<br>--- The fuel gas is lit and the flame adjusted, until it ceases to smoke.<br>--- The heating oxygen valve is then opened and adjusted (similar to a neutral flame setting) until there is a series of nicely defined white inner cones in the flame (in the case of the multi-port type nozzle) or a short white conical ring, if the nozzle is of the annular port type.<br>--- The cutting oxygen valve is then opened at this stage and the flame readjusted to a neutral condition. The oxygen cutting valve is then closed and the torch is ready for use.<br><br>Flame adjustment:<br>When oxy-propane is used for cutting, the correctly adjusted pre-heating flame will be indicated by a small non-luminous central cone with a pale blue envelope.<br>In the case of oxy-natural gas the flame is adjusted until the luminous inner cone has a clear definite shape, usually up to 8-10mm in length). | 2m<br><br>2m<br><br>2m |
| | b | | 6m |

| Parameters | Bolting | Riveting |
|---|---|---|
| Cost | Low cost | High cost |
| Reliability | Less | High |
| Labor skills | Unskilled to semi - skilled | Semi – skilled to skilled |
| Joint strength | Low (fluctuating loads) | High (fluctuating loads) |
| Joint State | Removable | Permanent |
| Material | Hard, Tough | Ductile |

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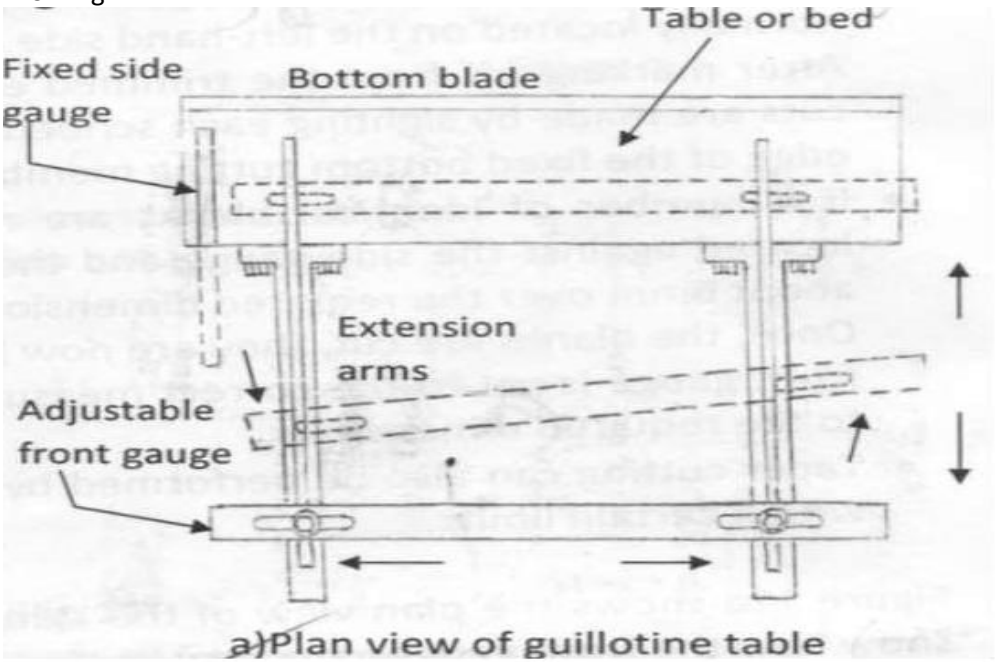
| | | | |
|---|---|---|---|
| **2** | | **Attempt any two:** | **8*2** |
| | a | Working:<br>  <br><br>a)Plan view of guillotine table<br>When power is transmitted to the blade it starts moving downward. A sufficient clearance is provided between the bottom and top blade. The top blabe is inclined at a considerable angle called as shear angle which is approximately 50 with horizontal because of which area under shear is greatly reduced and consequently the force required to shear the material is also considerably reduced<br>Shear Force= Area under shear X Shear strength of material<br>A typical guillotine machine is provided with fixed side gauge extension arm, adjustable front gauge, table or bed and bottom blade as shown in figure. The sheet to be cut is held against fixed side gauge and the front and back gauges are adjusted according to the required dimension of sheet to be cut. | **4m Diagram**<br>**4m Explanation** |
| | b | Neutral Line:<br>The boundary line between the area under compression and the area under tension in any angle bend is called as neutral line.<br>The neutral line is unaffected by the action of any forces (compression or tension).<br>The neutral line tries to keep the component in original position.<br><br>Bend allowances for sheet metal: | 02 Marks |

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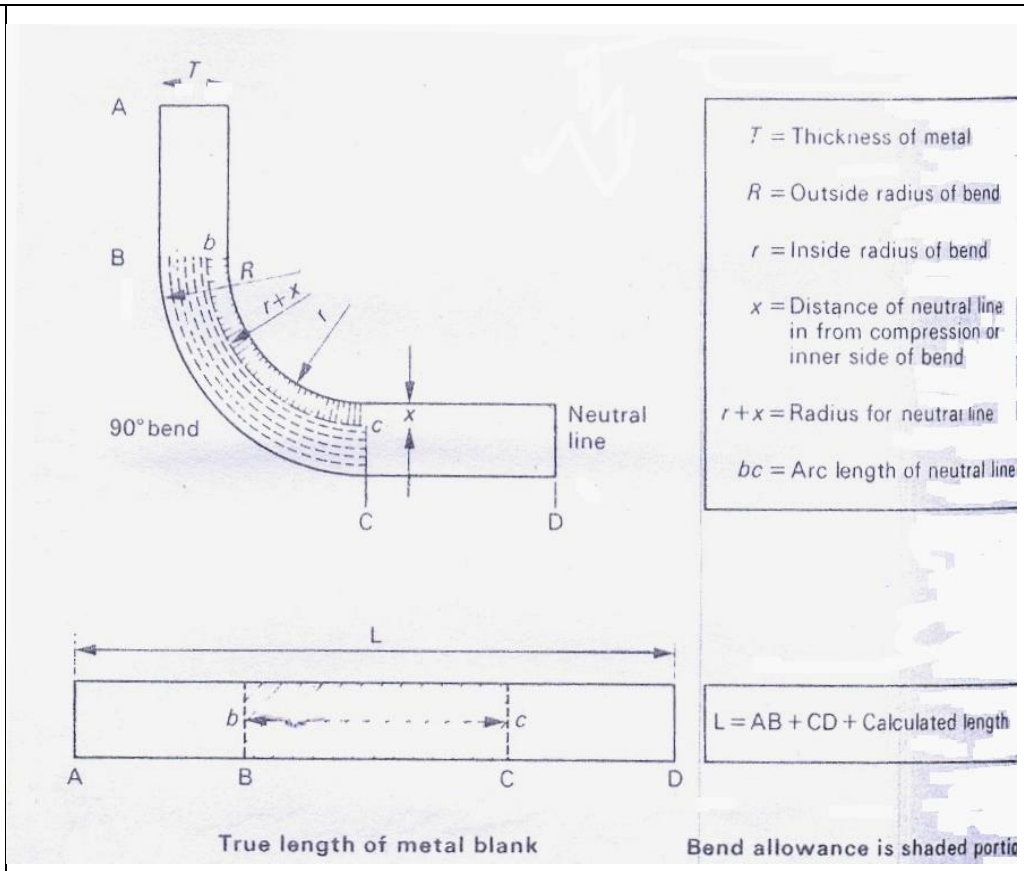


02 marks

When sheet metals are bent through angles of 90$^{o}$ the material on the outside surfaces becomes stretched, whilst that on the inside surfaces of the bends is compressed. It is therefore necessary to make an allowance for these effects when developing a template or when marking out a blank sheet for bending.

02 marks

Thus, bend allowance implies determining the length of the neutral line in the portion of the bend instead of the inside or outside dimensions of the bent metal. The neutral line is an imaginary curve somewhere inside the metal in the bend. Its position does not alter from the original flat length during bending.

For the purpose of calculating the allowance for a bend in sheet metal the neutral line curve is regarded as an arc of a circle whose radius is equal to the sum of inside bend radius and the distance of the neutral line in from the inside of the bend. Arc lengths are dependent upon their sector angles and can be determined by calculations as follows:

Consider an arc of radius, r+x = 100mm whose subtended angle is θ=90°.

Then its length will be;

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| | | | |
|---|---|---|---|
| | | 90/360 × 2π(r+x)<br>Alternatively, by inspection the ratio 2π /360 is a constant which may be used for<br><br>all bend allowance calculations i.e.<br>2 π/360 =2 ×3.142 /360<br>=0.0175<br>Thus the length of the arc will be :<br>0.0175 ×(r+x) ×θ<br>=0.0175 ×100 ×90°<br>=157.5mm<br>From the above it will be seen that a formula is derived for calculating bend allowances as follows;<br>BEND ALLOWANCE = 0.0175 ×INSIDE RADIUS TO THE NEUTRAL LINE ×SUBTENDED ANGLE OF THE BEND | 02 marks |
| | c | Technique of cutting a round bar --- When a round bar is to be flame cut, it is advisable to make a nick with a cold chisel at the point where the cut is to start. This enables the flame cutting to be started more easily.<br><br>Once the cut is started, the cutting torch should be moved steadily and at a uniform speed, with the small cone of the pre-heating flame just clear off the work surface.<br><br>There must be no vibration of the cutting head as such movements will result in a ragged cut and in some cases, the cut being halted.<br><br>+Advantages and applications<br>1.At least 3 times faster than chipping.<br>2.Maybe used with existing oxy-fuel gas cutting equipment.<br>3.Useful for removing weld defects, lugs, cleats, tack welds, etc.<br>4.Dismantling structures, removing risers and gouging cracks prior to welding.<br>Preparing abutting edges for welding. | 4m<br><br>4m |

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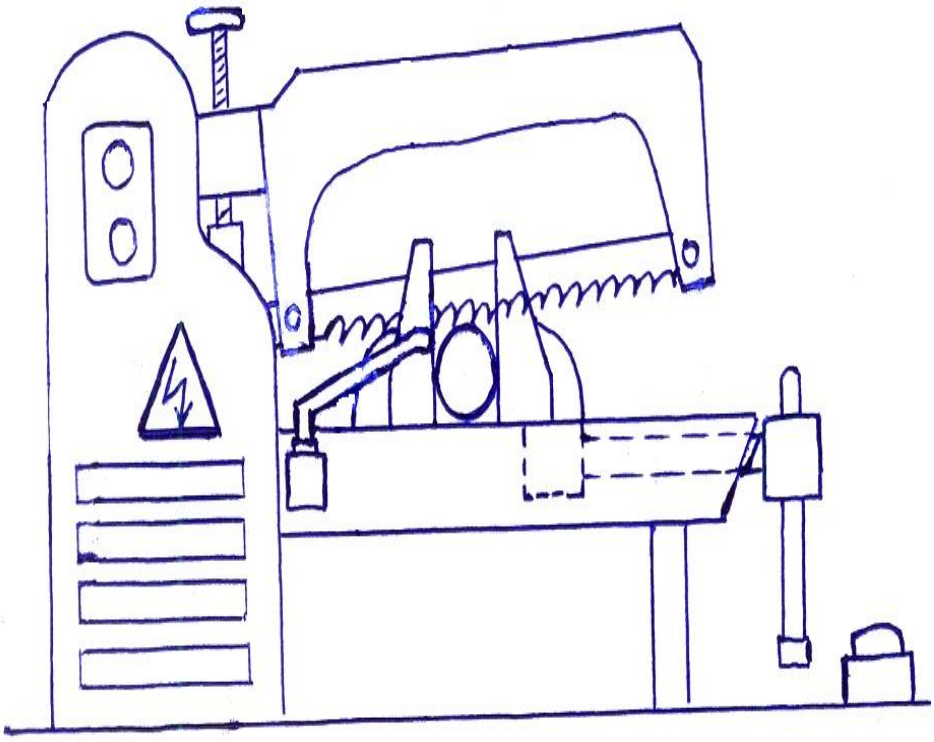
| | | | |
|---|---|---|---|
| **3** | | **Attempt any two:** | **8*2** |
| | **a** |  | 2m (diagm.) |
| | | Reciprocating Power Hack Saw is the most efficient sawing machine as compared to all other straight blade machines.<br><br>It has a power operated reciprocating mechanism for convenient cutting of work piece. The Thickness width of blade is comparatively large than hand sawing machine blade.<br>Here coolant is required during operation for providing smooth cut and lubrication during process. The machine is having a provision of vice to hold the work piece in position and any length of work piece can be cut on this saw<br><br>All types of sections within the range of capacity of this saw can be cut.<br><br>Metal sawing is one of the important cutting operations chiefly | 2m Explanation |

| | | | |
|---|---|---|---|
| | | concerned with cutting bar stock to a convenient length or size for machining. In metal sawing, the individual teeth of the saw "track" through the work, each tooth deepening the cut made by the preceding<br><br>tooth in the direction of feed. Either the saw or the work may be fed and by controlling the direction of feed, either straight or curved cut can be produced. The width of the cut is approximately equal to the width of the saw itself.<br><br>**Safety Precautions for reciprocating power hacksaw:**<br><br>•Cutting teeth and the blade should be positioned to cut on the draw stroke.<br>•Blade should be so tightened that the tension is adequate to hold the blade firmly during the cutting operation.<br>•Blade pins should be checked regularly to ensure that they are not being sheared.<br>•The work piece should be tightened securely<br>•Ends of long pieces, projecting from the power hacksaws must be supported using a roller stand.<br>•Cut-off sections must be cooled before handling to avoid burns and cuts from burred pieces.<br>•Cutting fluid must be directed towards the cutting area and cutting saw teeth.<br>•Before starting the power hacksaw, blade must be moved away from the work.<br>•Cutting fluid and reservoir must be kept clean. Regular testing for the ratio of water and oil and correcting of fluid ensures that the evaporation of liquid does not change the efficiency of the cutting fluid. | 4m<br><br>Safety Precautions<br><br>(Any 4) |

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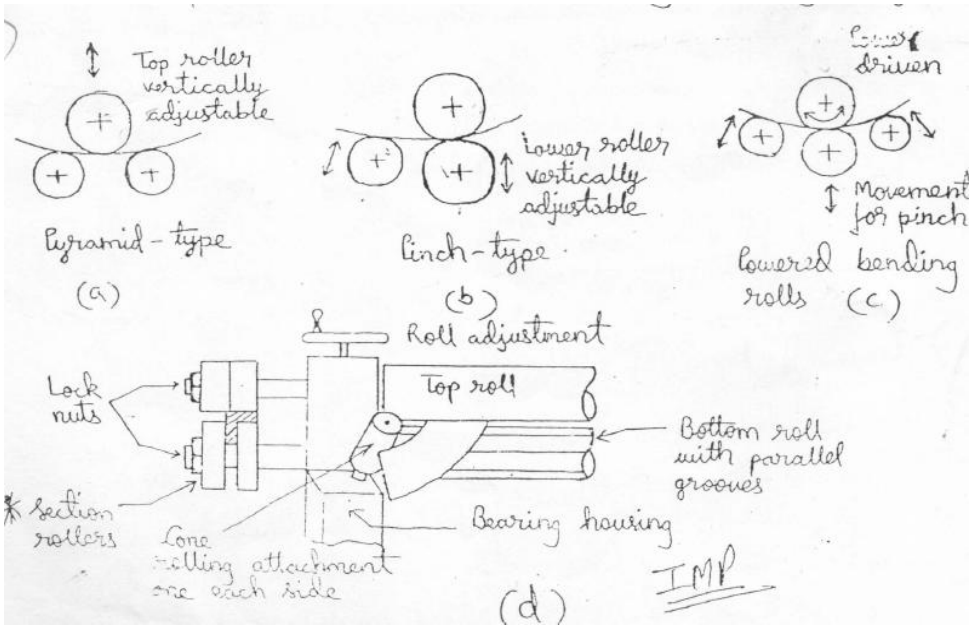
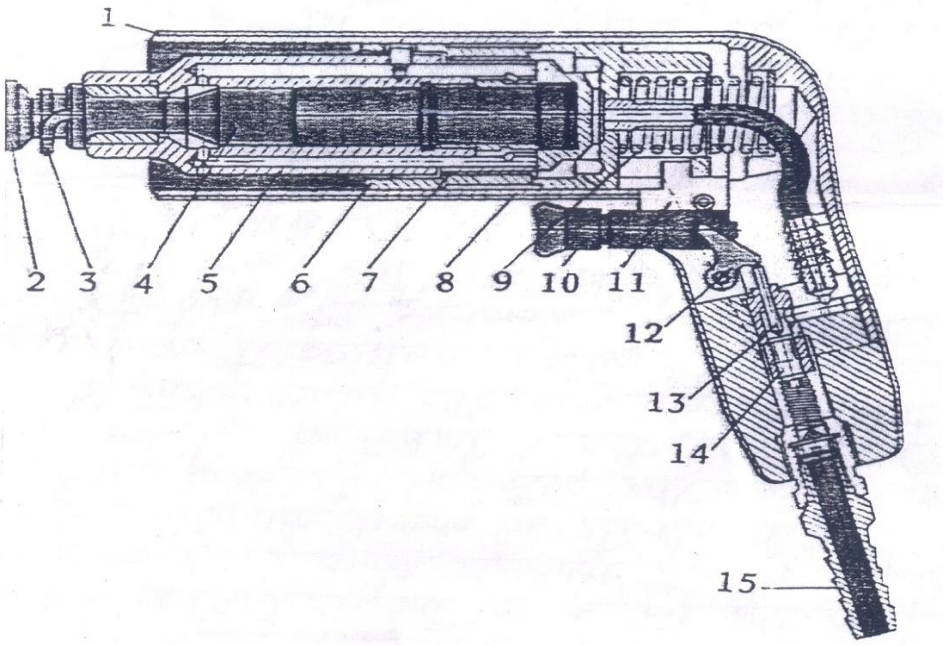
| | b |  <br>Cones may be formed by adjusting the front roller or on the pyramid type; by the use of a cone rolling attachment or by sloping the top roll. Some machines have an additional attachment for rolling angle and bar sections. This attachment is an extension of the rolls, but positioned outside the bearing housing | 4m<br>2m<br>2m |
| | c | Riveting methods are<br>1.Hand riveting<br>a.Direct method<br>b.Blind method<br>2.Power riveting<br>3.Hot Riveting<br>4.Cold riveting<br><br>Power riveting: Large parts are mainly riveted with pneumatic hand hammers and to a lesser extent with electric hammers. As seen from the figure below, when trigger (10) is depressed with the finger, it acts through lever (12) on the plunger (13) which admits compressed air into valve (14). As this takes place, the piston shoots down and heads the rivet and the distribution valve opens a port for letting the air into the lower chamber of the cylinder, under the piston, making it move upwards. Spring (9) serves for damping the piston's back blow and thus protects the operator from harmful effect of vibrations and spring (3) prevents the die from | 8m |

falling out.

In operation, the pneumatic hammer is held by the handle with the right hand and the trigger is depressed with the forefinger. The left hand grips the tool by the barrel or the die to keep the latter on the rivet head. Riveting with a pneumatic hammer is done by two workers; the riveter operates the hammer and the holder-on holds the dolly bar.

Pneumatic riveting hammer

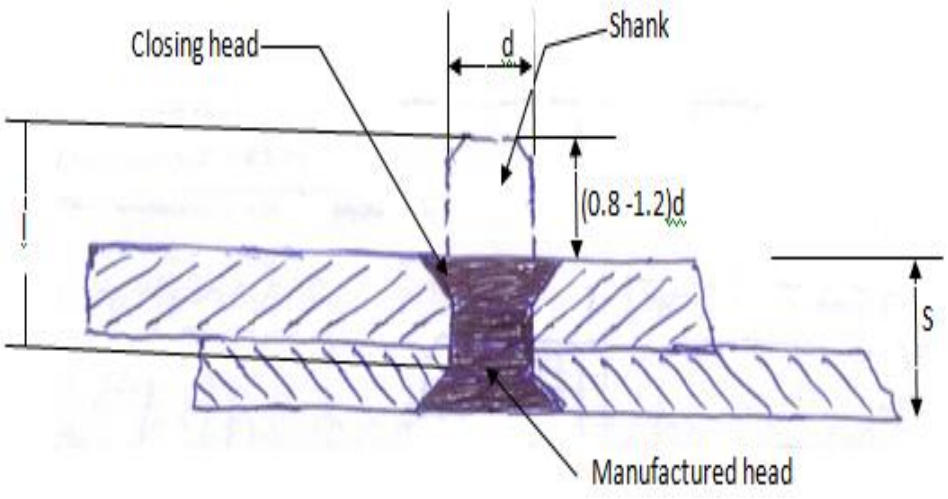
1 – body;
2 – riveting die;
3, 9 – spring;
4 – setting punch;
5 – cylinder;
6 – sleeve;
7 – distribution valve;
8 – cover;
10 – trigger;
11 – handle;
12 – lever;
13 – plunger;
14 – starting valve;
15 – nipple



Allowances for rivet:

Regardless of the equipment used, components to be riveted are so located that the manufactured heads are disposed from above. Such an arrangement allows the rivets to be inserted beforehand.

- The required number, diameter and length of rivets in a joint are found by calculation. The shank length is chosen to correspond to the thickness of the plates to be joined and the shape of the closing head.
- The length of the shank portion to form a countersunk head should be;
  l= s+ (0.8 to 1.2)d, where
  l= rivet shank length in mm,
  s= thickness of plates being joined in mm,
  d= shank diameter in mm.




- Pitch i.e. the distance between adjacent rivets (t) and distance from centre of rivet to edge of plate (a);
  For single riveted joint, t= 3d; a= 1.5d
  For double riveted joint, t=4d; a= 1.5d,
  where, d= rivet diameter

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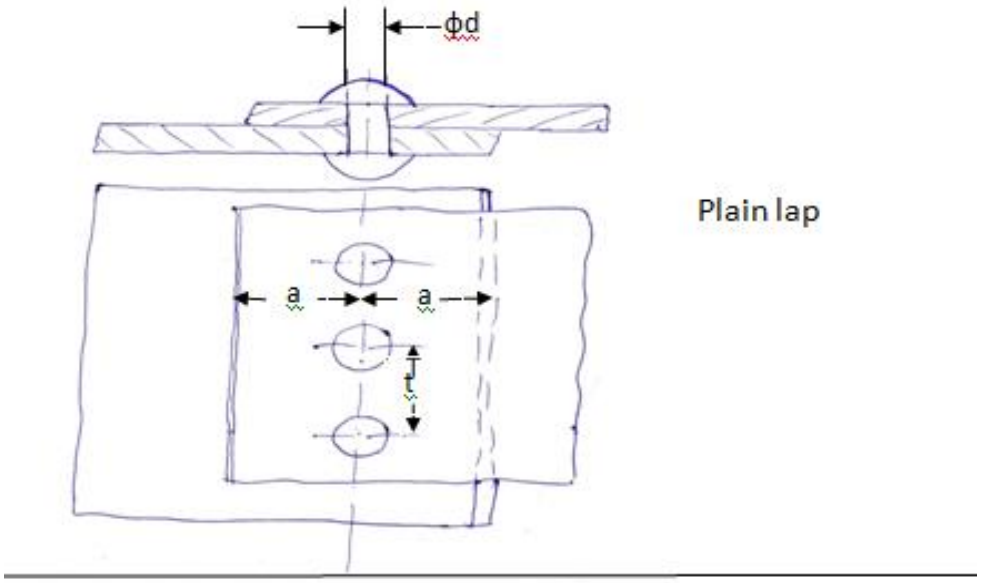


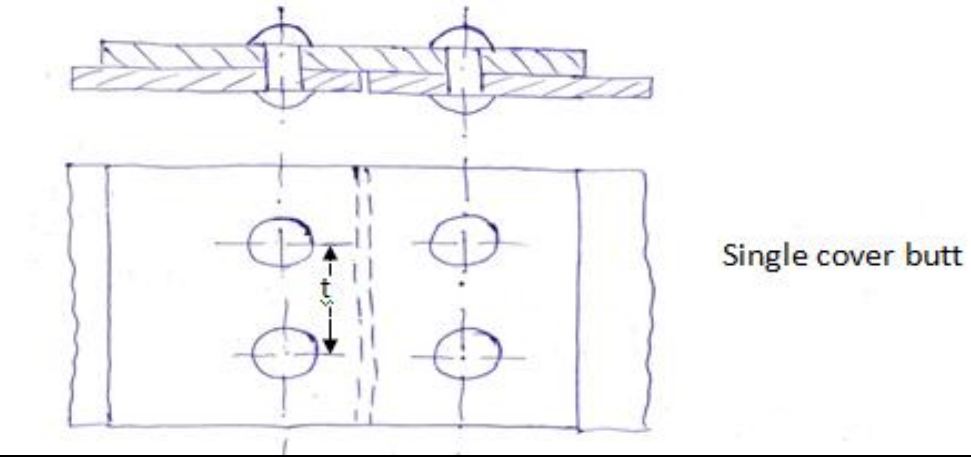


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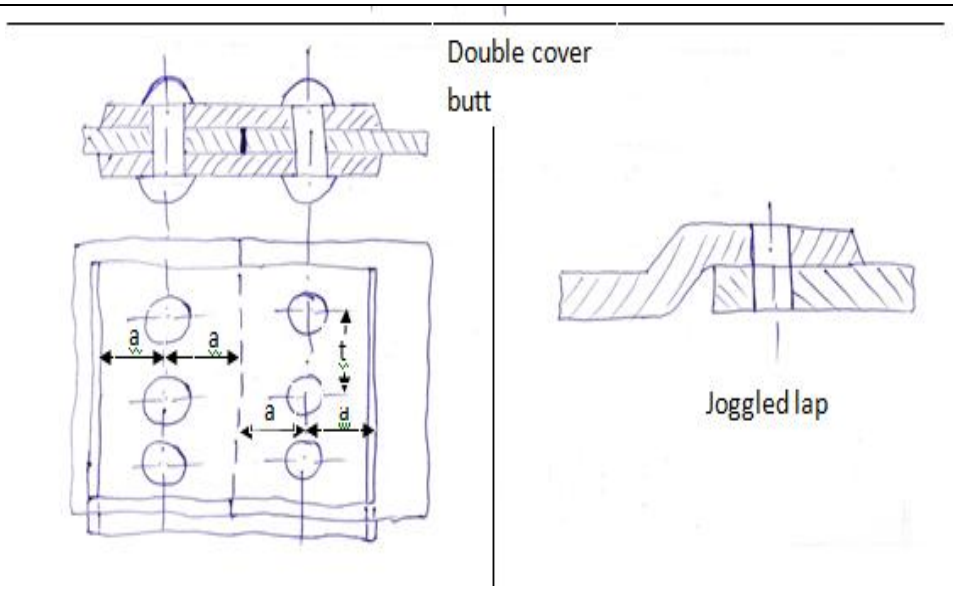


| | | | |
|---|---|---|---|
| **4.** | **A** | **Attempt any Three:** | **3*4** |
| | a | | 4m (Any 4 points) |

| Parallel Shaft Machine | Inclined shaft Machine |
|---|---|
| 1.Positon of shaft axis of upper and lower cutter are horizontal | 1.Positon of shaft axis of upper and lower cutter are inclined with respect to horizontal |
| 2.These are usually hand operated | 2.These are both hand and power operated |
| 3.Special adjustment for cutter is not possible | 3.Special adjustment for cutter is possible |
| 4.Accurate clearance not possible in parallel shaft machine | 4.Accurate clearance possible in inclined shaft machine |
| 5.It has adjustable guide | 5.No requirement of adjustable guide |
| 6.Spur gears are used for transmission | 6.Bevel gears are used for transmission |
| 7.Difficulty in cutting circular plates | 7. Circular plates can easily be cut. |

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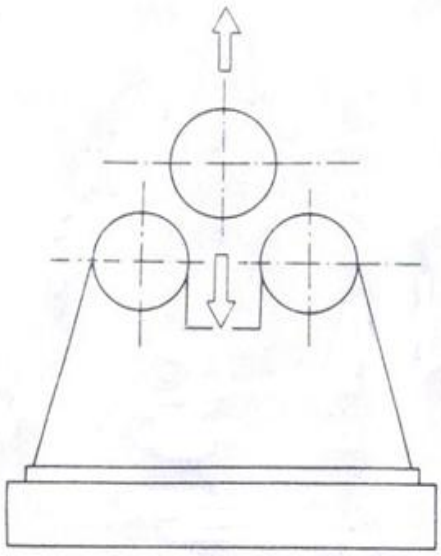
| | b |  <br>*(a)* Pyramid-type rolls (standard design)<br><br>Pyramid-type rolls, as the name suggests have three rolls arranged in pyramid fashion as shown. Most plate rolling machines are provided with longitudinal grooves along the lower rolls to assist in gripping the plate. These grooves are useful for initial alignment of the plate. | 2m<br><br>2m |
| | c | Applications of flame cutting:<br>-Useful for removing weld defects, lugs, cleats, tack welds, etc.<br>-Dismantling structures<br>-Removing risers<br>-Gouging cracks prior to welding<br>-Preparing a butting edge for welding | **4m**<br>**(Any 4)** |
| | d | Hand Sawing:<br><br>Advantages:<br>Simple toolings<br>Fitting operations on site works<br>Tube cuttings<br>Can cut in space constraints<br>Ease in maneuverability | 2m |

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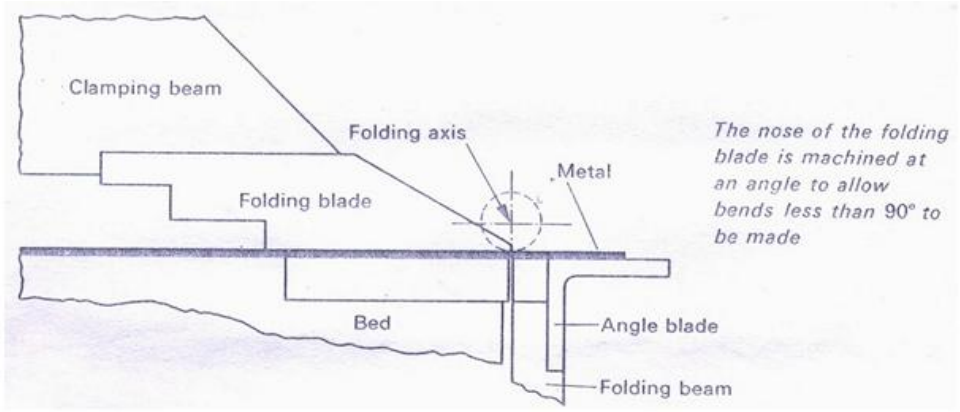
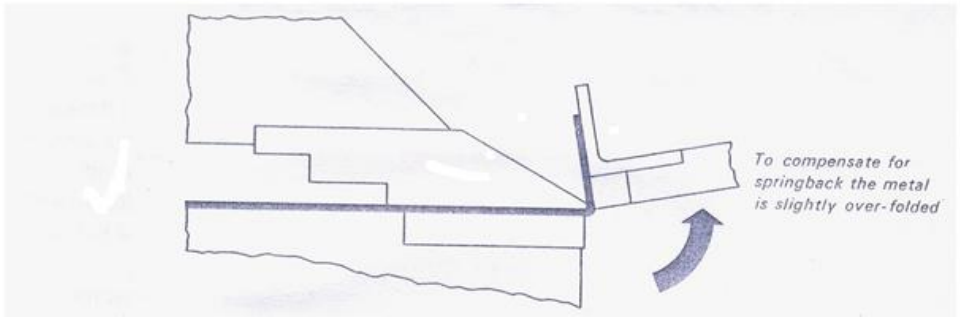
| | | | |
|---|---|---|---|
| | | Disadvantages<br>1.More time consuming<br>2.Limited job handled<br>3.High thickness and large jobs cannot be handled<br>4.Skill required for cutting | 2m |
| | **B** | **Attempt any one:** | **1*6** |
| | a | The elastic recovery of shape of the job in the bent zone on removal of the bending forces is known as 'springback'.<br><br>Methods of compensating for Spring Back are:<br>-On folding machine<br>-On Press Brake or Fly Press<br>-Air Bending<br>-Coining<br><br>• On a folding machine:<br>The clamping beam on a folding machine is specially designed to compensate for spring back. This is illustrated in the figures shown below.<br>  <br>  | 1m<br><br>5m for Any one Explanation |

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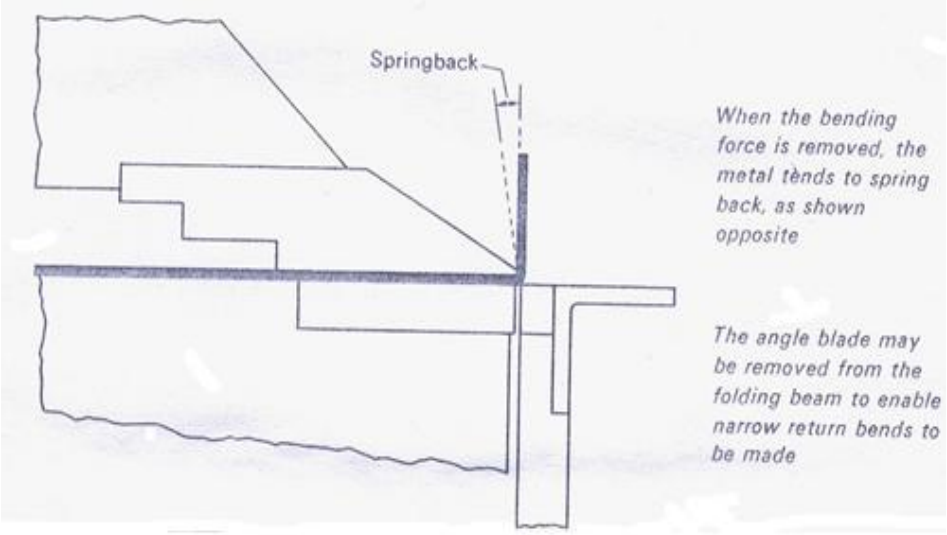
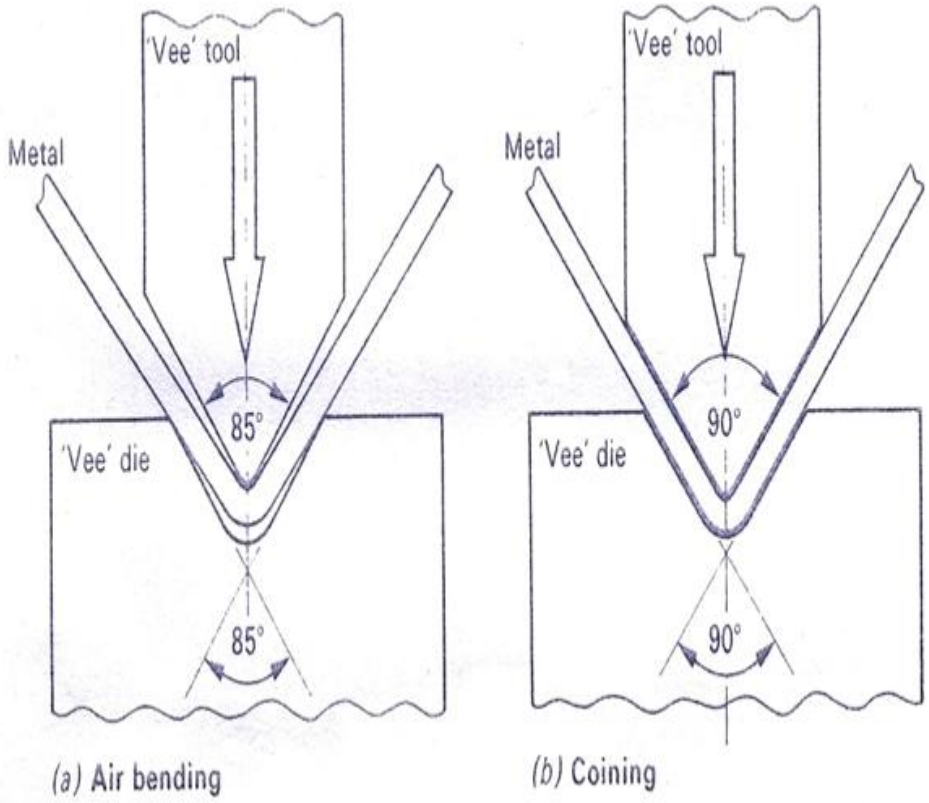



OR

- On a press-brake, or a V-tool in a fly press: In this there are two methods of reducing springback as shown in the figures below.




3m (for diagrams)

and

3m (for explain)

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| | | | |
|---|---|---|---|
| | | Air bending --- This allows partial bending and various angles to be bent by three point loading. The three points are the two edges of the V-die (bottom tool) and the nose of the V-punch (top tool).<br>During air bending, the sheet or plate retains its elasticity. In this case the bending angle must be over-closed to compensate for the springback of the material after removal.<br>The bending tools are designed accordingly, both the top and bottom V's have an included angle of less than 90 . In general, the angle of these tools is 85 .<br><br>Advantages in air bending:<br>1)Less power required to bend the material.<br>2)Ability to bend heavy sheets and plates.<br>3)Ability to form various angles with the same tooling.<br>Disadvantages in air bending:<br>1)Inaccuracy in angle bends.<br><br>Coining --- This type of bending can be compared with a deep-drawing operation. The nose of the V-tool crushes the natural air bending radius on the inside of the bend. This compression removes the elasticity of the sheet or plate. This results in the bend retaining the exact angles of the bending tools. Both tools have an included angle of 90 .<br>Advantages in coining:<br>1)High angular accuracy in angle bends.<br>Disadvantages in coining:<br>1)More power required to bend the material.<br>2)Inability to bend heavy sheets and plates.<br>3)Inability to form various angles with the same tooling. | |
| | b | • Die Ratio:<br>Die ratio is defined as the ratio of 'Vee' opening in the bottom of tool (width at die opening) to the thickness of metal to be bent.<br><br>Die Ratio = W/t<br><br>Where, W= Width at the die opening<br>t = thickness of metal to be bent<br><br>Advantages<br>1.It shapes or cut metal without removal of chips<br>2.It is intended for mass production.<br>3.It represents the fastest processes<br>4.It is most efficient process to form a sheet metal into finished products. | **2m**<br><br>**2m** |

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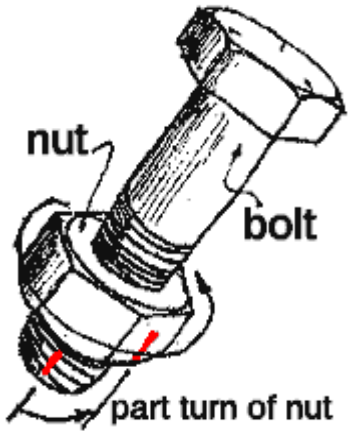
| | | | |
|---|---|---|---|
| | | Disadvantages<br>1.They have complex construction and structure<br>2.Intial cost is high<br>3.Highly skilled labours are required for performing operation on power press<br>4.Failure of mechanism may result in interruption of work. | **2m** |
| **5** | | **Attempt any two:** | **8*2** |
| | a | Tightening of HSFG bolts: Each bolt is assembled with one washer in cases where plane parallel surfaces are involved. The washer is placed under the bolt head or nut, whichever is to be rotated during the tightening operation (A tapered washer must be used if angle is above 3°).<br><br>Driving of bolts is not permitted. If, after final tightening, a nut or bolt is slackened off, it must not be used again.<br><br>Since it is important that the torque on the nuts is correct for the bolt, a pre-calibrated impact wrench is used, or the part-turn method, or a feeler gauge if load indicating bolts or washers are being used as shown in the figures below.<br><br>(Bolts must be tightened in a definite sequence).<br><br>Turn of Nut (Part Turn Method):<br><br>  <br><br>**Turn-of-Nut** | 2m<br><br>2m |

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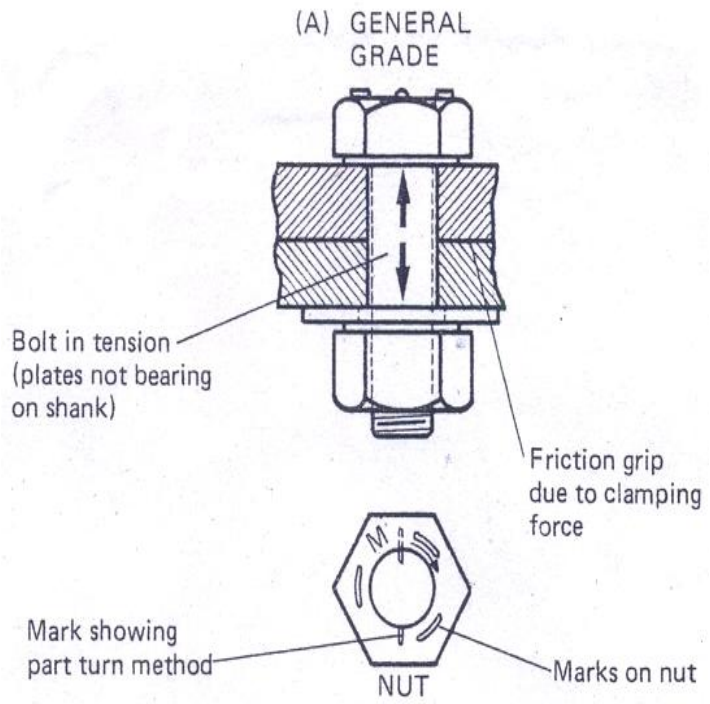


**2m**

After snugging the joint, the bolt shank and nut is marked and then a specific amount of rotation is induced between the nut and the bolt. The amount of rotation differs for different bolt lengths and diameters and therefore must be known and understood by the bolt installers in advance. The success of the method is dependent on a correct snugging of the joint, and is dependent on the bolt head being held from turning so the bolt does not spin in the hole.

Two persons are therefore mandatory to execute this method correctly: one to hold the bolt from turning or "rolling" and the other person to operate the wrench. Note: Turn-of-nut does not work correctly when the steel surfaces are coated

with a compressible coating such as high paint thickness or hot dipped galvanized zinc.

Nut rotation requirements for tensioning the Friction type bolts by the part-turn method:

| | | | | | |
|---|---|---|---|---|---|
| | | Bolt length (measured from underside of head to end of bolt) | Nut rotation | | |
| | | Upto and including four bolt diameters | One-third to five-twelfths of a turn | | |
| | | Over four but less than eight diameters | One-half to seven-twelfths of a turn | | |
| | | Over eight but less than twelve diameters | Two-thirds to three quarters of turn | | |

Calibrated wrench tightening method: In this method the bolts are tightened by a wrench as shown below, calibrated to produce the required tension. For this method of tightening the calibrated torque wrench may be hand operated or, for larger bolt diameters or large numbers of bolts, power operated. It is essential to check the tightening equipment in combination with the bolts and nuts to be tightened very regularly, using special prestress-measuring devices.

Torque control:

The torque control method requires the use of a manually operated torque wrench or power driven wrench to achieve the required bolt tension. The manual torque wrench incorporates a gauge or other method to indicate the amount of torque transferred to the nut or bolt as shown below. **2m**

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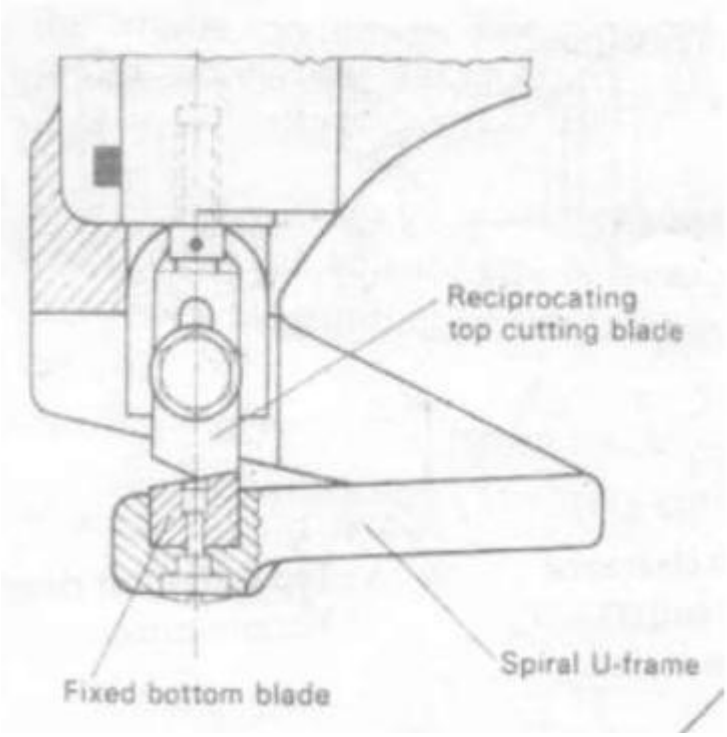
| | | | |
|---|---|---|---|
| | b | Shear Type Nibbler:<br>  <br><br>The shear type nibbler: This portable power tool is used for rapid and accurate straight line or curved cutting of material up to 4.5mm thickness. It is basically a short stroke power shear fitted with a rapidly reciprocating cutting blade, so that each stroke makes a cut approximately 3mm in length.<br>The shear type nibbler is fitted with a pair of very narrow flat blades, one of which is usually fixed and the other moving to and from the fixed blade at fairly high speeds. Generally these blades have a very pronounced Rake to permit piercing of the material for internal cutting, and since the blades are so narrow, the sheet material can be easily manoeuvred during cutting.<br>The top blade is fixed to the moving member or ram and the bottom blade on a spiral extension or 'U' frame. This extension is shaped like the body of a 'throatless shear', to part the material after cutting.<br>There is usually provision for vertical adjustment to allow for resharpening of the blade by grinding and an adjustment behind the bottom blade to allow for setting the cutting clearance.<br>figure above shows details of the 'shear type nibbler'.<br>The spiral U-frame is designed to assist in parting the metal after it has been sheared. | **3m**<br><br>**3m** |

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| | | | |
|---|---|---|---|
| | | **Advantages of nibblers:**<br>-These are portable machines<br>-Any complex shapes can be easily cut<br>-Requires less time<br>-Semi skilled oprator can perform this operation | **2m** |
| | c | **Effect of shearing angle:**<br>The basic principle in bench shear and all guillotines used for straight line cutting is that one blade is fixed (bottom blade) and the moving blade (inclined to the fixed blade) is brought down to meet the fixed blade.<br>When the cutting members are arranged parallel to each other the area under shear would be the cross-section of the material being cut i.e. length X thickness of plate<br>If the moving blade is inclined(given a shearing angle of approximately $5^0$ ) then the area under shear is greatly reduced and consequently the force required to shear the material ids also considerably reduced.<br><br>**Effect of clearance and rake angle on blades:**<br>**Rake Angle:**<br>The shear blades are provided with a rake angle of 30(approx.) and an optimum rake angle enables the blades to dig into the material, thereby subjecting the internal fibres of the metal to plastic deformation prior to shearing.<br>Too much of the rake angle weaken the blades and too less a rake angle requires more force to initiate plastic deformation.<br><br>**Clearance:**<br>There must be sufficient clearance between the cutting edges of the blades to help in the cutting action.<br>An approximate rule is that the clearance should not exceed 10% of the thickness to be cut and must be varied to suit the particular material.<br><br>**Basic Principle of Shearing:**<br><br>The standard type of bench shear and all guillotines are used for straight-line cutting. The basic principle of these machines is that one blade is fixed (bottom blade) and moving blade (inclined to the fixed blade) is brought down to meet the fixed blade | **2m**<br><br>**4m**<br><br>**2m** |

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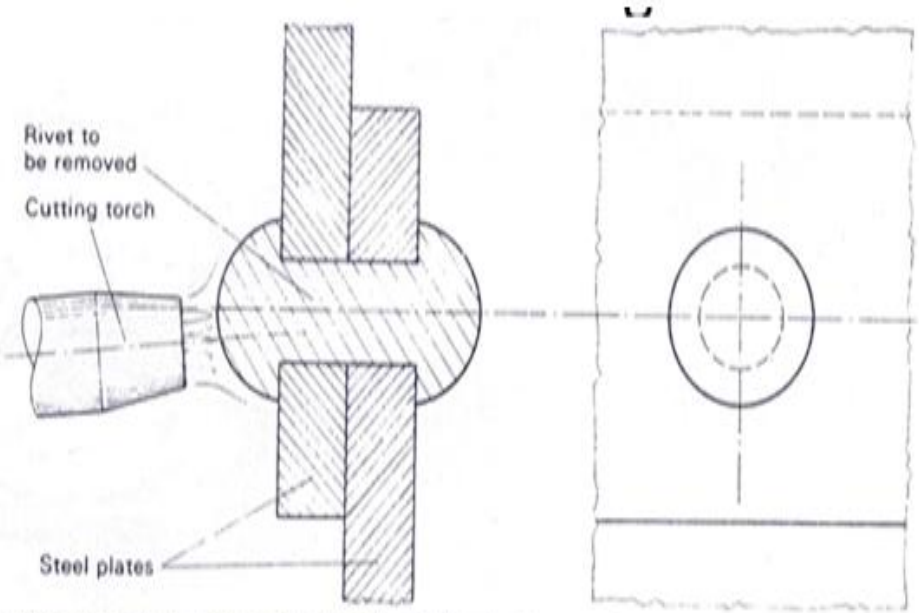
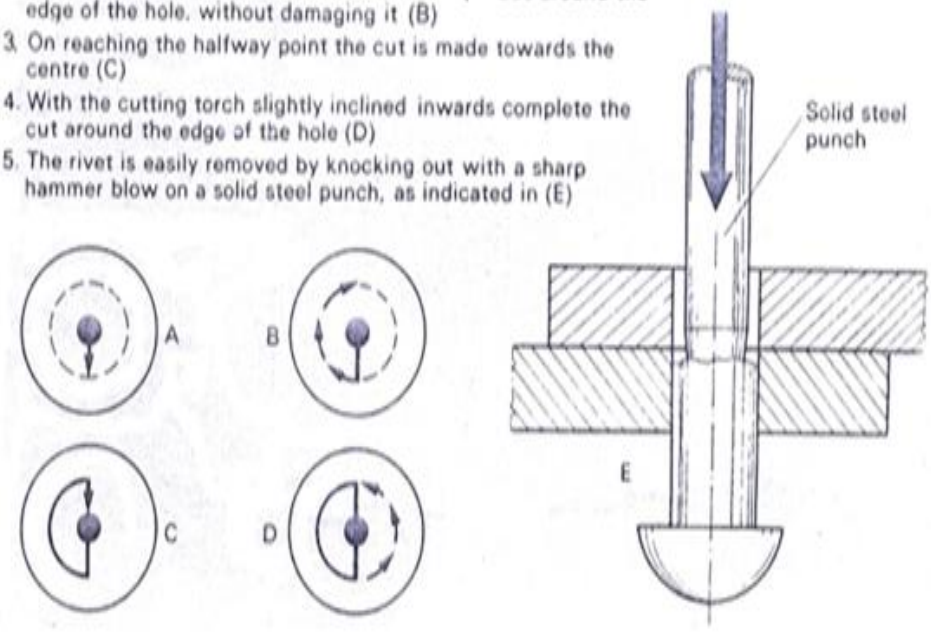
| 6 | | **Attempt any four:** | **4*4** |
|---|---|---|---|
| | a | **Rivet removal by gouging:**<br>  <br>1. The centre of the rivet head is heated until bright cherry red, and the edge of the hole becomes clearly visible (A)<br>2. The cutting oxygen jet is turned on, and with the torch slightly inclined towards the centre, a cut is carefully made around the edge of the hole, without damaging it (B)<br>3. On reaching the halfway point the cut is made towards the centre (C)<br>4. With the cutting torch slightly inclined inwards complete the cut around the edge of the hole (D)<br>5. The rivet is easily removed by knocking out with a sharp hammer blow on a solid steel punch, as indicated in (E)<br>  | 2m (for the Explanation)<br><br>and<br><br>2m (for the sketches) |

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| | | | |
|---|---|---|---|
| | **b** | • Mechanical drive systems:<br>i) This has a fixed tonnage and delivers more force at the bottom of its stroke than at the half-way point.<br>ii) Mechanical drives will cycle its ram at more strokes per minute than a hydraulically driven system of the same size.<br>iii) The electric motor provides power to a flywheel which stores energy and provides speed and consistancy of motion to the drive shaft on a mechanical system.<br>iv) The ram starts at high speed from the top of the stroke and automatically changes into low speed for the operating position of the stroke. At the bottom of its stroke, the ram again transfers into high speed for its return. A control mechanism provides short, medium and long periods of time for the ram at slow speeds.<br>v) Mechanical press brakes are easier to overload.<br>vi) Difficult to bring ram close to material for scribed line work. Difficult to control bending speeds.<br>vii) Skilled operator needed to slip clutch. Clutches requires adjusting.<br>viii) Mechanical press brakes do not enable you to adjust the stroke length. You must complete the revolution and cycle the machine completely, you cannot return the ram at any position of the stroke.<br><br>• Hydraulic drive systems:<br>i) These are available with pressing capacities upto 8000 tonnes.<br>ii) A mechanically driven press brake of equal tonnage will not deliver the same pressure at the bottom of their strokes, it is rated at midstroke.<br>iii) The hydraulic press brakes delivers its rated capacity over the entire stroke. The hydraulically driven press brake's tonnage and ram speed are variable upto the machine's rated limits.<br>iv) A hydraulic drive allows a longer ram stroke than mechanical driven equipment.<br>v) The ram speed control on a hydraulic press allows the best adjustments of the material being worked.<br>vi) The tonnage of a hydraulic press brake is a function of the size of its cylinders, pump and circuit capacity. The hydraulic press brake's fixed tonnage cannot be surpassed so the brake can be bottomed at full tonnage repeatedly without risk. This is its advantage over the mechanical press brakes.<br>vii) The hydraulic driven ram will stop when it reaches the selected tonnage. It can be withdrawn from any point on the job.<br>viii) It is possible for the ram to be positioned within a thousandth of an inch. A job requiring repetition can be set up to produce identical parts in minutes. This capability is not available with mechanical press brakes. | 2m<br><br>2m |

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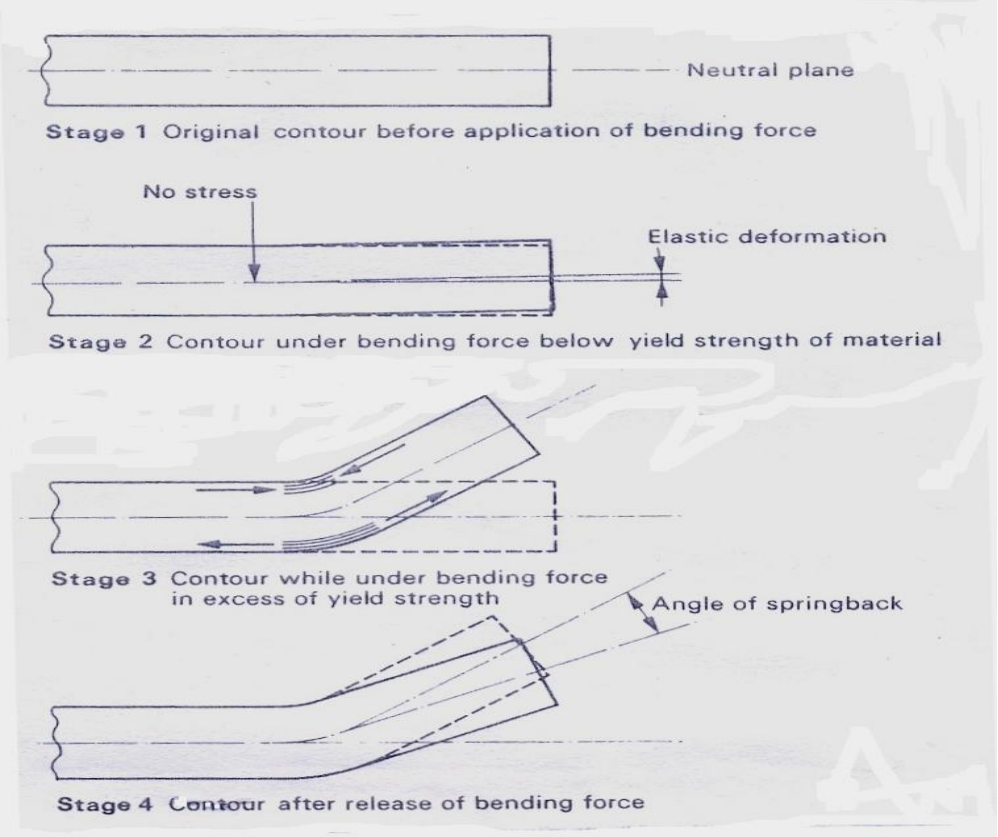
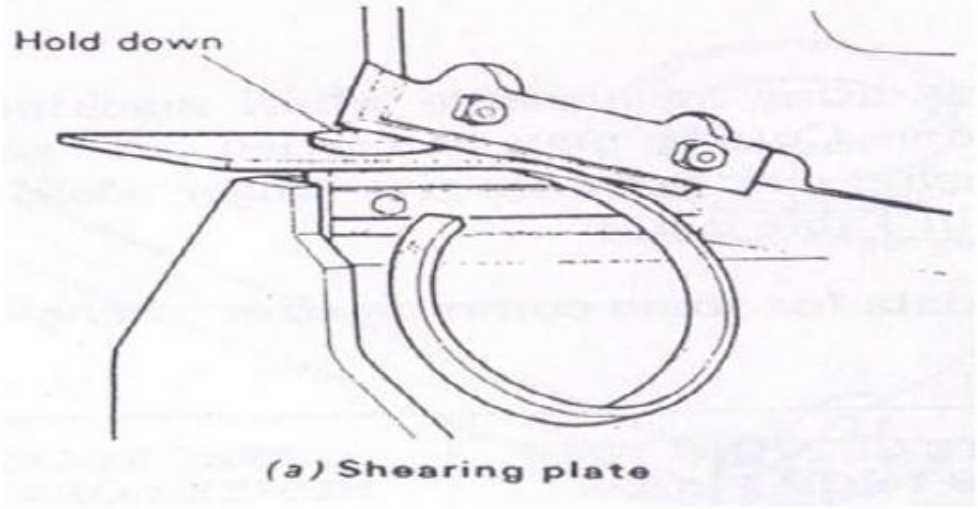
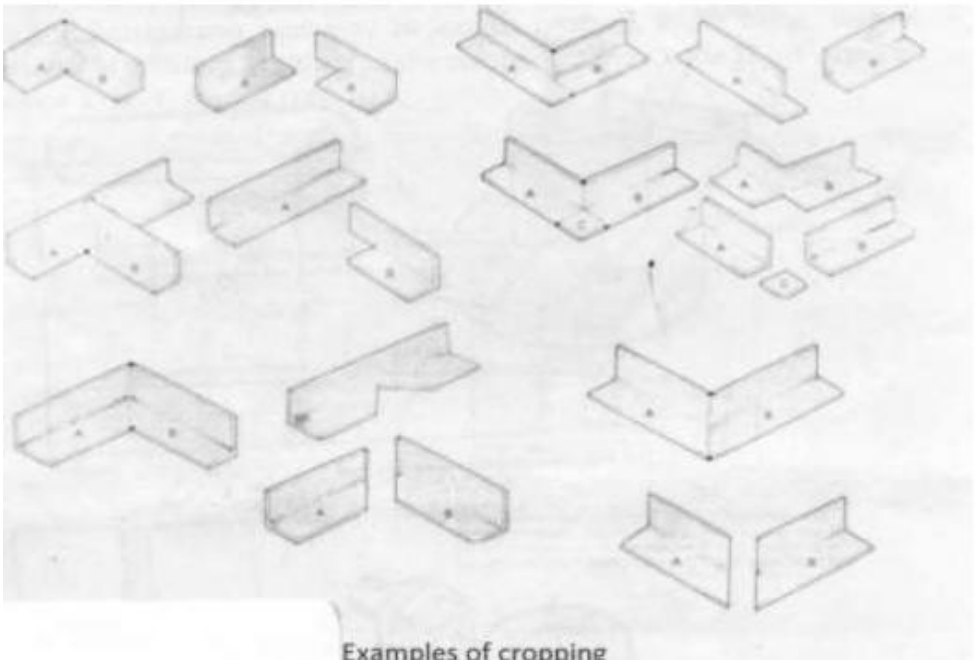
| | | | |
|---|---|---|---|
| | | ix) The hydraulic press brakes delivers full rated power throughout its stroke and has a longer stroke than a mechanical brake which is limited in stroke length by its crankshaft design. | |
| | **c** |  <br>The mechanics of bending: When a bending force is gradually applied to a workpiece under free bending conditions, the first stage of bending is elastic in character. This is because the tensile and compressive stresses that are developed on opposite faces of the material are not sufficiently high to exceed the yield strength of the material. The movement or strain which takes place as a result of this initial bending force is elastic only, and upon removal of the force the workpiece returns to its original shape.<br><br>As the bending force is continued and gradually increased, the stress produced in the outermost fibres of the material eventually exceeds the yield strength.<br><br>Once the yield strength of the material has been exceeded, the movement or strain which occurs is plastic. This permanent strain occurs only in the outermost regions furthest from the neutral plane. Between the outermost fibres and the | 2m<br><br>1m |

| | | | |
|---|---|---|---|
| | | neutral plane there is a zone where the strain produced is elastic.<br><br>On release of the bending force, that portion adjacent to the neutral plane loses its elastic stress, whilst the outer portions, which have suffered plastic deformation, remain as a permanent set. Thus the elastic recovery of shape in this zone on removal of the bending force is known as 'springback'. | 1m |
| | d | Cropping: | 2m |





Examples of cropping

Cutting by shearing is quick and probably the most economical production method. The shearing of rolled steel sections is performed indies designed to suit the section. The dies are mounted in a special shearing machine. This operation is commonly referred to as cropping.

NOTCHING

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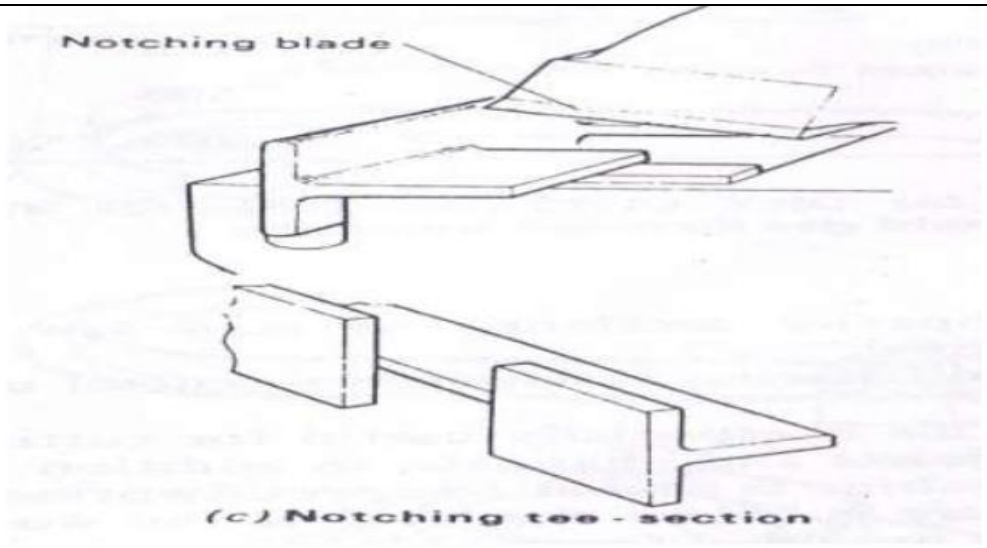
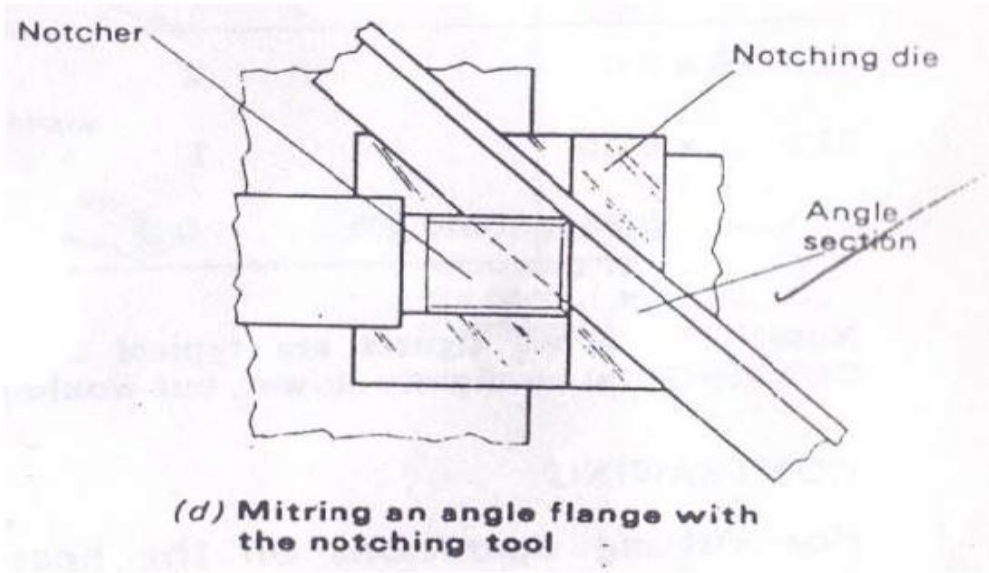



(c) Notching tee - section




(d) Mitring an angle flange with the notching tool

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| | | | |
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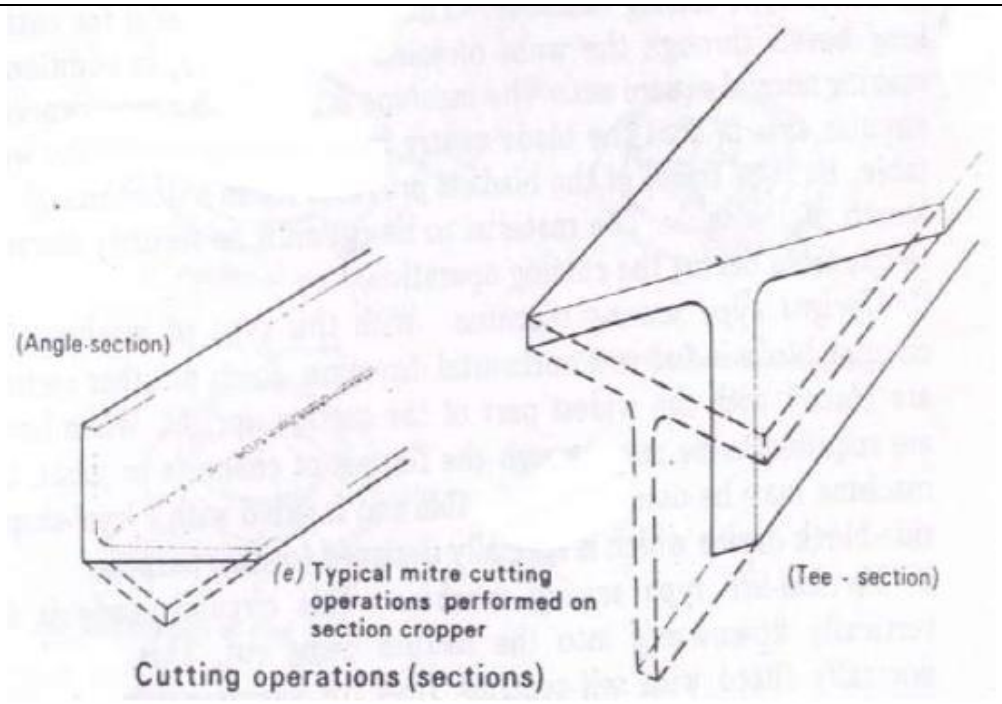
| | |  <br>Notching is removal of material by making a notch. In most fabrication shops, cutting operations on rolled steel sections are carried out on power machines. Machines are available which perform a combination of cutting operations, such as punching, shearing and notching, the shearing operations including not only section shearing, but round and square bar cropping and plate shearing. Angle section has to be notched in order to permit it to be bent and most of the notches are of the 'V' notch or the square-notch type | |
| | **e** | Shearing essentials(Rotary cutters)<br><br>1. The edges of the cutter must overlap by smallest amount consistent with clan cutting. Excessive overlap tends to distort the material. Insufficient overlap does not shear the material.<br><br>2.There must be clearance between the working edges of the cutters and a means to adjust this.<br><br>3.Both cutters must run dead true, both on face and diameter. | 4m |

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| | | | |
|---|---|---|---|
| | f | **Blanking Pressure:**<br><br>The action of a punch in cutting material on the edges of a die is partly shearing and partly tensile rupture.<br><br>With soft material, action of a pure shear is more nearly approached.<br><br>With hard and strong material, the action will be more likely tensile type of failure<br><br>The pressure required to produce a blank is measure of the combined tensile, shear and perhaps compressive strengths of the material.<br><br>BLANKING PRESSURE = Ultimate shear stress of material X Area being sheared<br><br>= Ultimate shear stress X Perimeter of blank thickness | 4m |