Trade of Metal Fabrication	
Module 3:	Plate Fabrication
Unit 7:	Sloping Chute
	Phase 2

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Document Release History

Date	Version	Comments
18/12/06	First draft	
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Module 3 – Plate Fabrication

Unit 7 – Sloping Chute

Duration – 8 Hours

Learning Outcome:

By the end of this unit each apprentice will be able to:

- Read and interpret drawing
- Mark out, shear, flame cut, bend, assemble and weld the components of a sloping chute

Key Learning Points:

Rk Sk	Handling of materials, use of crane and lifting tackle.
Rk Sk	Marking out, economic use of materials.
Rk Sk	Bending – bend allowance inside and outside dimensions. *(Also see Module 3 Unit 1).*
Rk Sk	Shearing – safety procedures. *(Also see Module 1 Unit 4).*
Sk	Oxy-fuel gas cutting.
Rk Sk	M.A.G.s welding process – different gases, wires. *(Also see Module 2 Unit 10).*
M	Pythagoras Theorem, ratio of sides and angles. *(Instructor explains this in classroom).*
Sc	Centre of gravity –why its location is important when lifting – load balanced.
P	Communication, initiative, quality of work.

Training Resources:

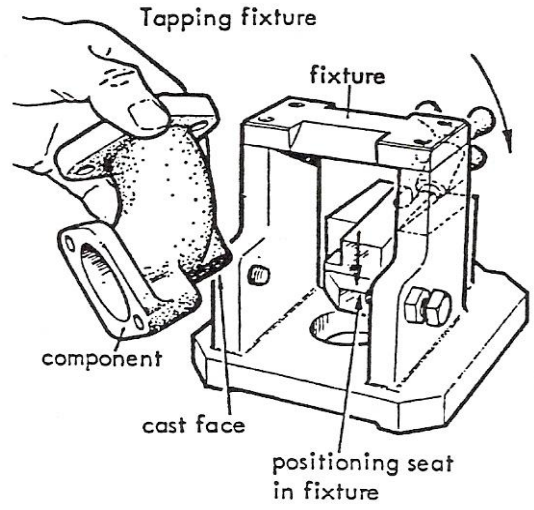
- Fabrication workshop
- Shears
- Press brake
- Oxy/fuel cutting equipment
- Apprentice tool kit
- M.A.G.s welding plant and equipment
- Safety procedures
- Safety clothing and equipment
- 5mm mild steel plate and 5mm flat bar

Key Learning Points Code:

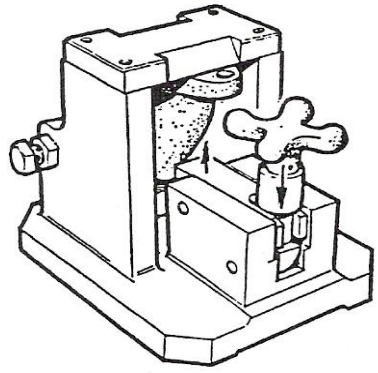
M = Maths D= Drawing RK = Related Knowledge Sc = Science

P = Personal Skills Sk = Skill H = Hazards

Jigs and Fixtures

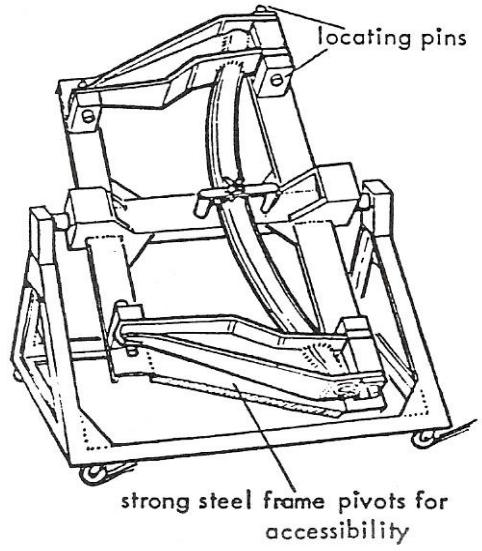


Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components. The purpose of the jig is to place each succeeding workpiece accurately in the same position, so that the operation to be carried out is done in the same way and in exactly the same place on all of them.



component positioned
securely for holes to be tapped

Welding fixture



The use of a jig or fixture makes a fairly simple operation out of one which would otherwise require a lot of skill and time. Both jigs and fixtures position components accurately and hold components rigid and prevent movement during working.

Dividers and Trammels

Dividers are a type of calipers used for measuring distances between two points, or parallel lines, on a flat surface and for transferring measurements taken direct from a scale on to another flat surface. Their greatest use is for scribing arcs or circles on flat surfaces up to about 150 mm diameter.

The Surface Gauge

The marking-out of work often includes the scribing of lines at a given height from some face of the work or the construction of lines around its several surfaces. To do this an instrument called a 'surface gauge' has been devised for holding the scriber. The surface gauge, commonly known as the 'scribing block' is mostly used for scribing lines parallel to a datum surface and for checking parallelism.

Datum Lines and Datum Edges

A DATUM can be defined as a fixed point, line or surface that can be used as a 'foundation' from which measurements may be taken.

Basic Methods used for Marking-Off Large-Size Plates

For economic reasons advantage should always be taken of as many good and straight edges as possible before commencing marking off large-size plates for cutting. Unnecessary shearing or flame-cutting can be avoided if the edges of the steel plates are examined before marking-off.

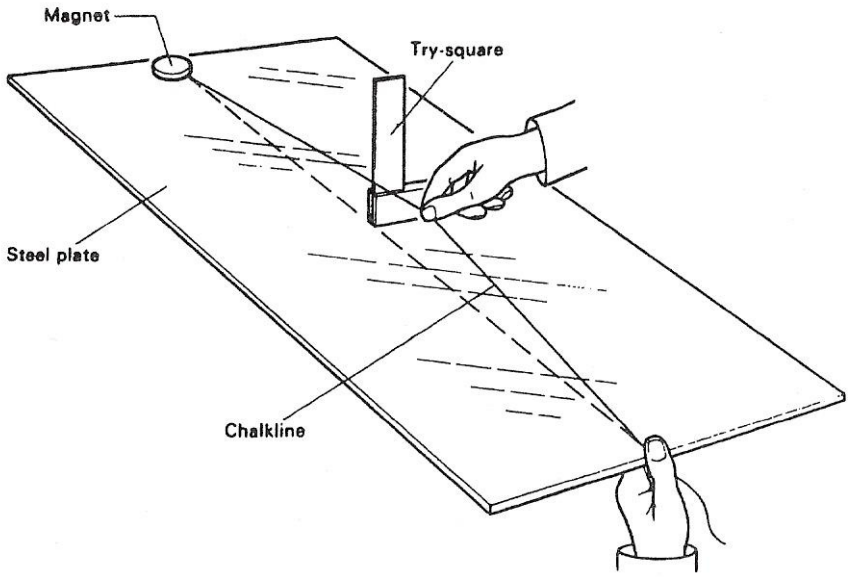


Figure 1 - The Use of a Chalkline for Marking Plate

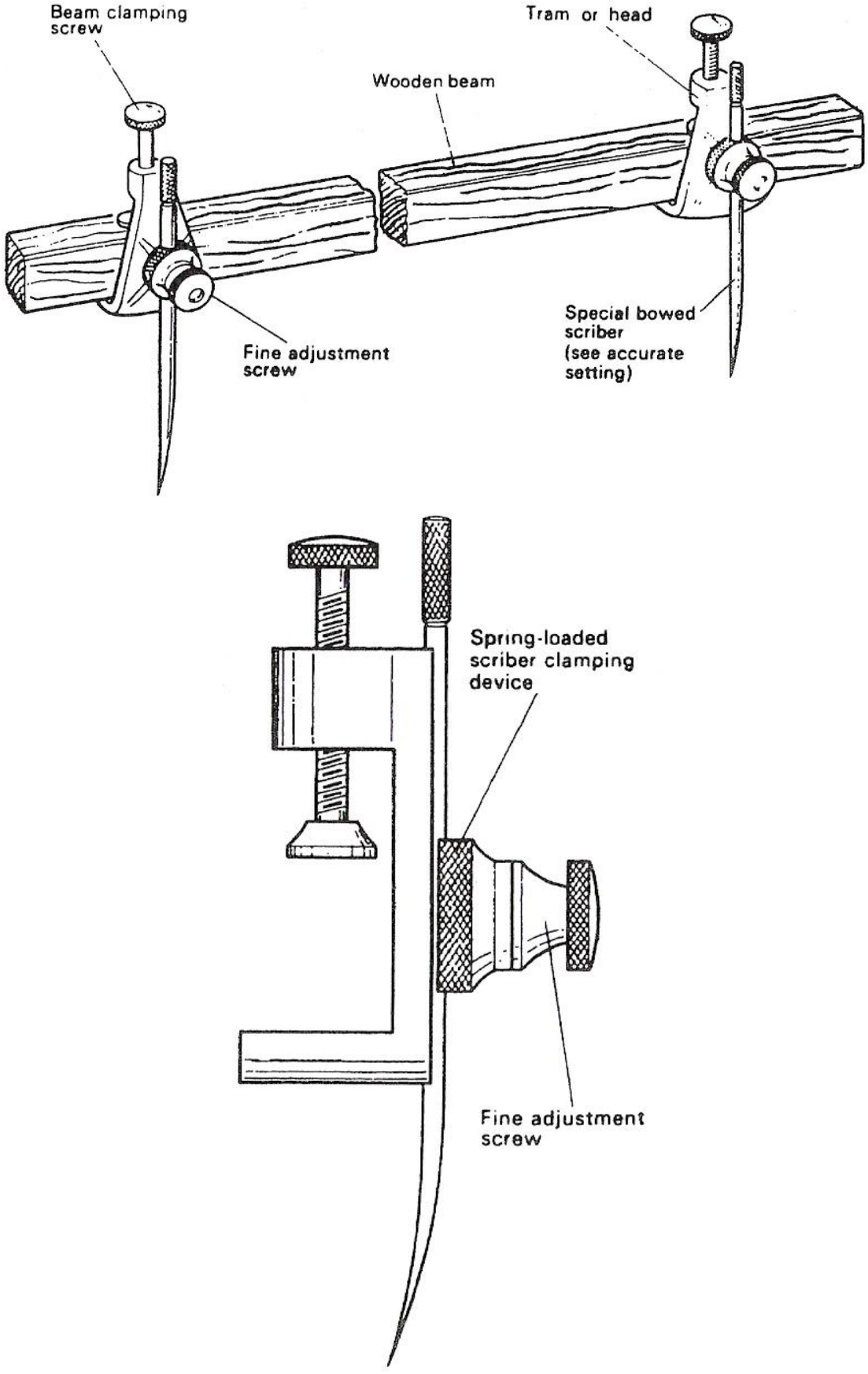


Figure 2 - Beam Trammels

BEAM TRAMMELS and TAPE MEASURES are used for striking lines at 90° to each other, and for measuring distances accurately. It is common practice for the craftsman to use a pair of trammel heads or 'trams' and any convenient beam such as a length of wooden batten.

A KNOWLEDGE OF GEOMETRIC CONSTRUCTIONS AND ARITHMETIC IS ESSENTIAL FOR MARKING-OUT.

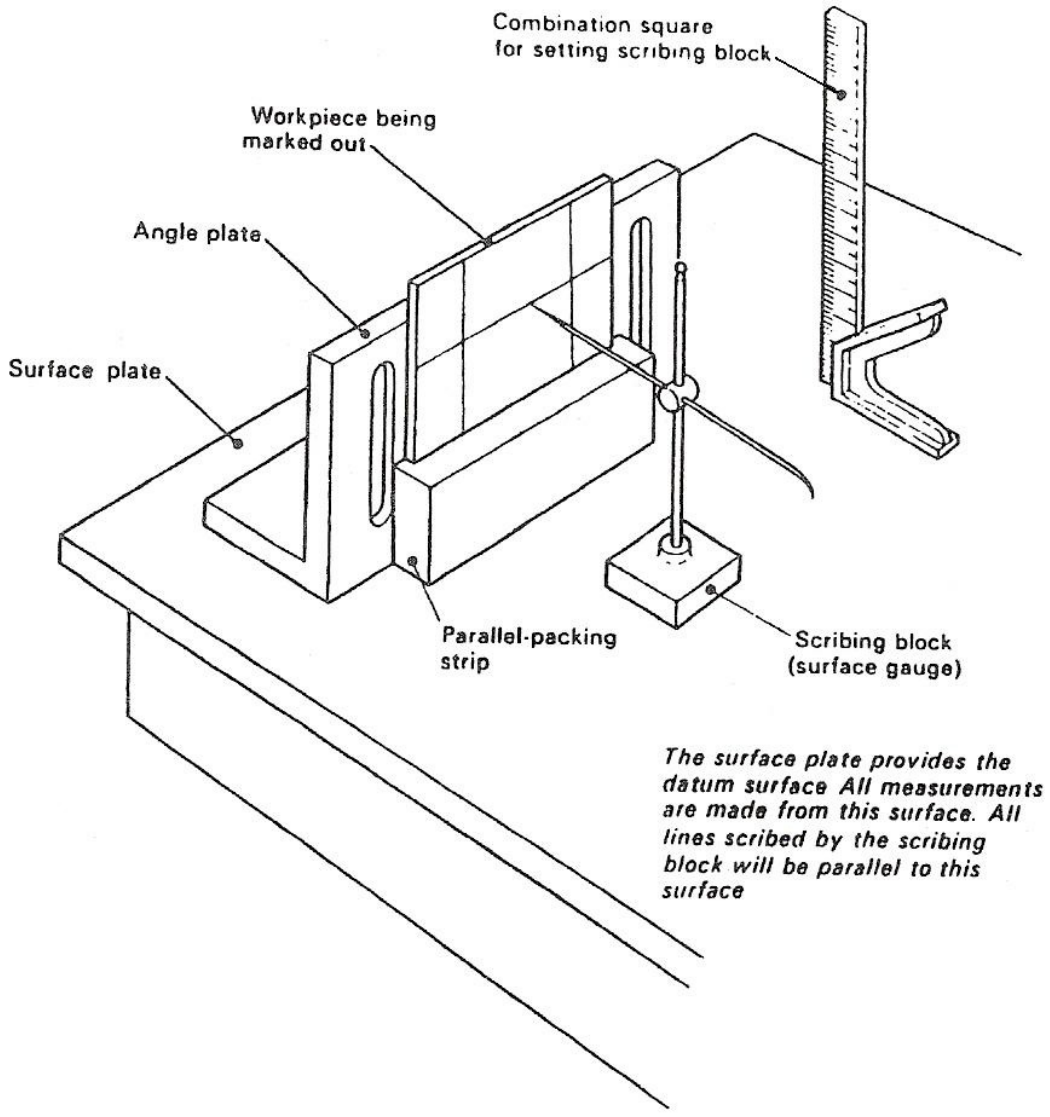


Figure 3 - Marking-Out from a Datum Surface

Marking Out with Try Square

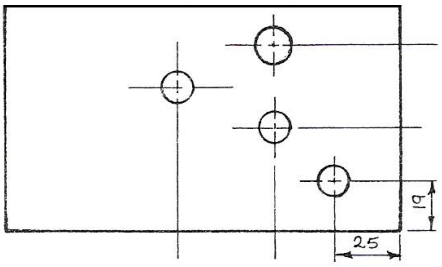
Preparation

150 x 75 x 6mm B.M.S. and B3.

Carry out the steps listed below to mark out hole centres on this material.

STEP 1

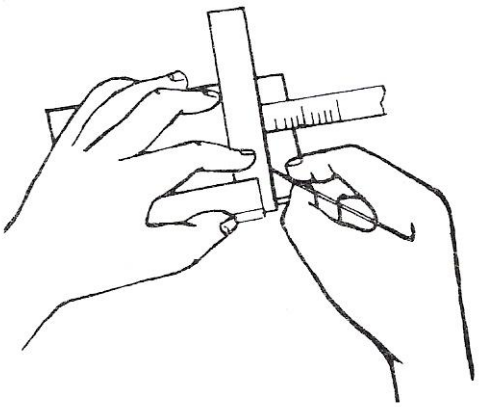
READ DRAWING



Decide which hole to mark first, note position of hole.

STEP 2

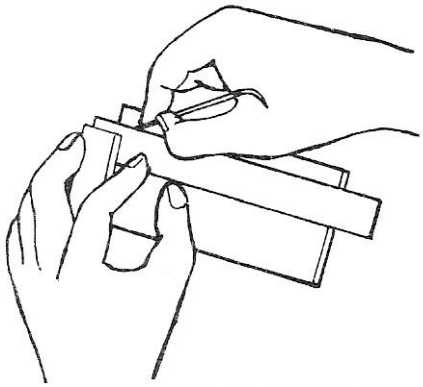
SCRIBE FIRST LINE



Using the rule, position square 25mm from edge of material and scribe a short line.

STEP 3

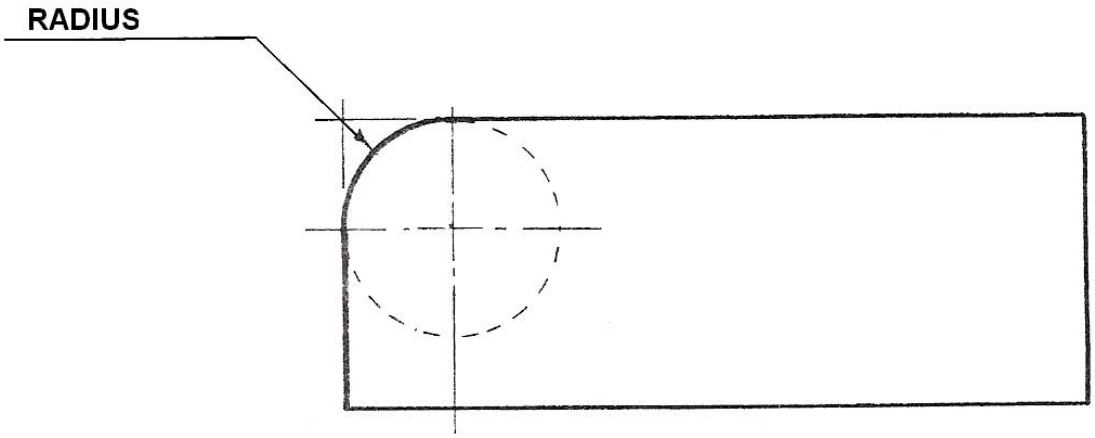
SCRIBE SECOND LINE

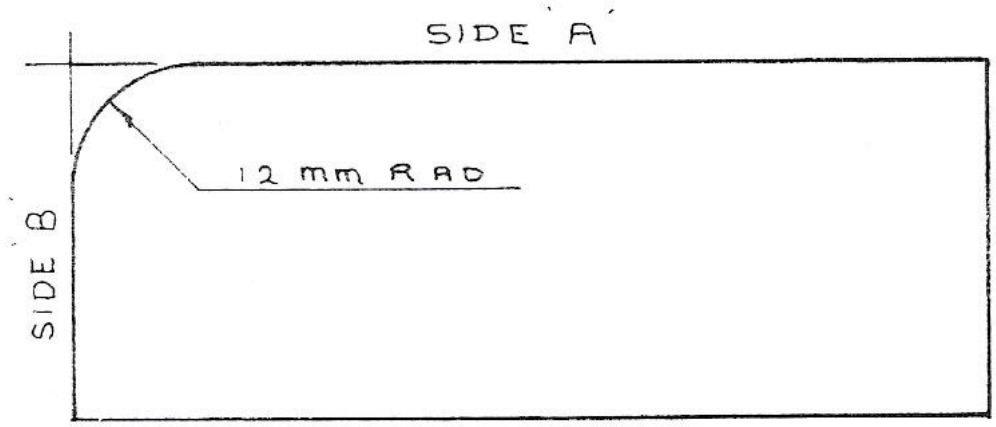


Position square 19mm from edge and scribe a short line crossing the first.

Reading Drawings

As well as marking positions for holes, you will also be required to mark RADII on metal plate as shown below.





This is how the radius would be shown on a drawing. From this drawing you would read that a centre point will be marked and will be 12mm from side A and 12mm from side B.

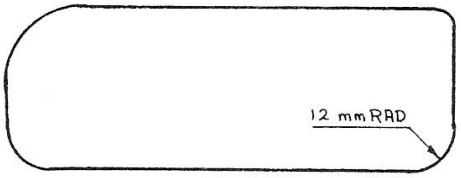
Marking Out with Dividers

Preparation

Take out your dividers and centre punch.

Step 1

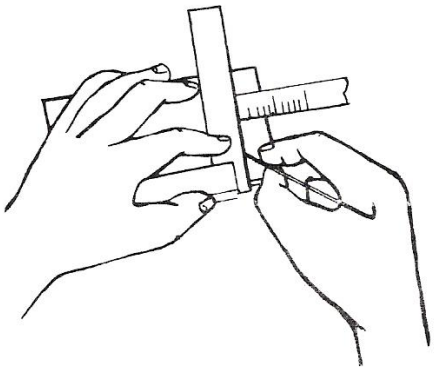
STUDY DRAWING B6



Select first radius and read information.

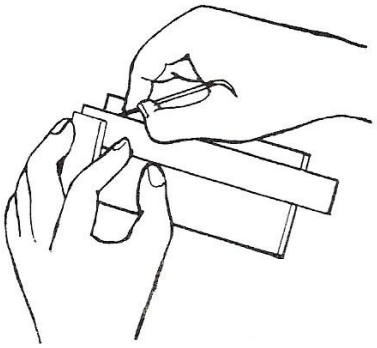
Step 2.

SCRIBE CENTRE POINT



Step 3

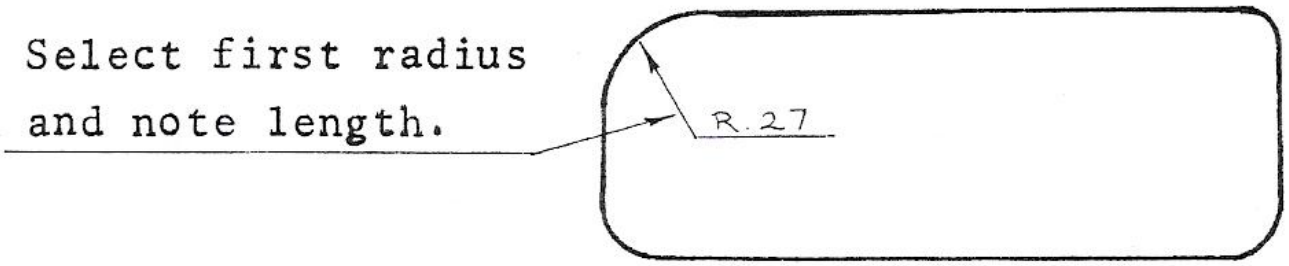
MARK IN THE REMAINING THREE, RADIUS CENTRE POINTS ON THE MATERIAL.



Step 4

LIGHTLY CENTRE PUNCH EACH OF THE CENTRES.

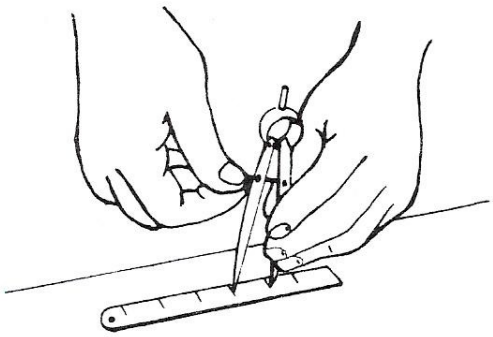
Step 5



Step 6

SET DIVIDERS

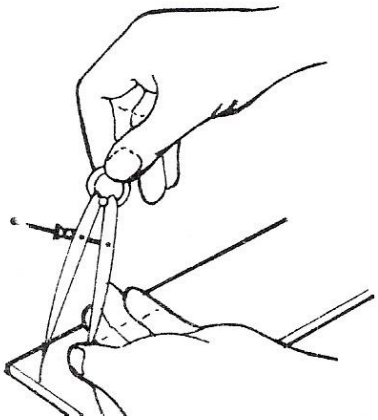
Rest rule on bench.
Set divider points
to length.



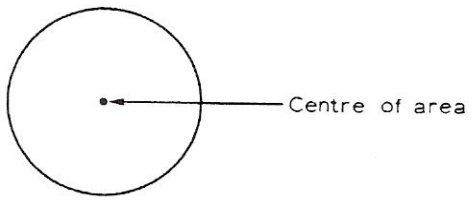
Step 7

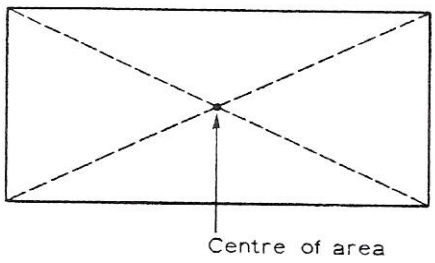
SCRIBE RADIUS

Use light pressure
when scribing with
dividers.



The Centre of Gravity of Regular Shapes and Solids





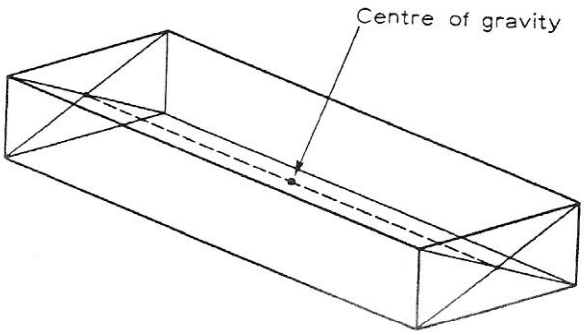
We will first consider the centres of area of common shapes.

Circular Area

The centre of area is at the centre of the circle.

Rectangular Area

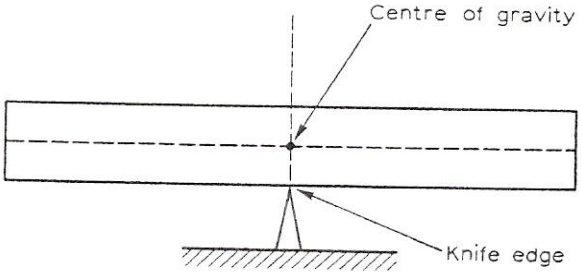
The centre of area is at the centre, i.e. at the intersection of the diagonals.



Centre of Gravity

Consider now a rectangular bar of metal of constant cross section.

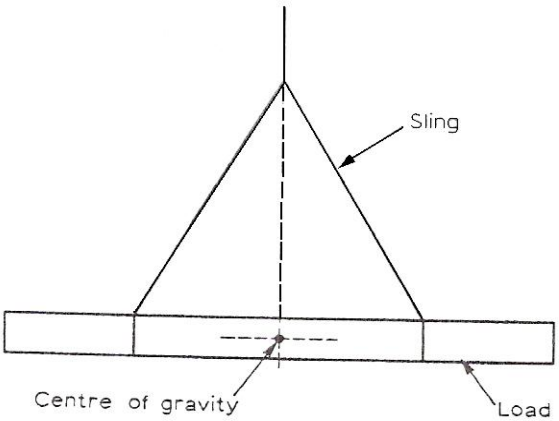
The centre of gravity or C.G. lies at a point half-way along its length on the centre line or axis.



If this bar is now balanced on a knife edge it can be seen that the e.g. is directly above the point of support.

It will balance because the moment due to that part of the weight on the left of the pivot will be equal to the moment due to that part of the weight on the right of the pivot, i.e.

The sum of clockwise moments =
the sum of anticlockwise moments.



Slinging and Hoisting

When a load is to be moved by slinging it is important that the load maintains a horizontal position.

It can be seen from above that for this to be so the crane hook must be positioned directly above the e.g. of the load being lifted.

Economic use of Materials

It is important to be mindful of the materials that you use in every way so as to avoid any wastage or at least to keep it to a minimum amount. For example, if a section has to be fabricated out of a large plate (6mm thickness), pieces may have to be folded / rolled and flanges may have to be cut out, gussets may have to be inserted and splice plates may have to be made to adjoin section to frame etc.

Plan out the job so as to utilise the plate as economically as possible and in turn you will be saving the company you are employed by or yourself wastage and money.

Centre of Gravity

Every particle of matter is attracted towards the centre of the earth and every object or body consists of a large number of particles. If the body is small compared with the earth, the gravitational forces on all the particles of the body can, for practical purposes, be regarded as being parallel with one another. These parallel forces can be replaced by a resultant force equal to the weight of the body and having its line of action passing through a point termed the centre of gravity (abbreviation, c.g.) of the body. In other words, the mass of a body may be regarded as being concentrated at its centre of gravity and its weight acts vertically through that point. The location of the centre of gravity is independent of the position of the body. If a body is suspended by a cord, the vertical upward force exerted by the cord must be equal to the weight of the body and its line of action passes through the centre of gravity of that body.

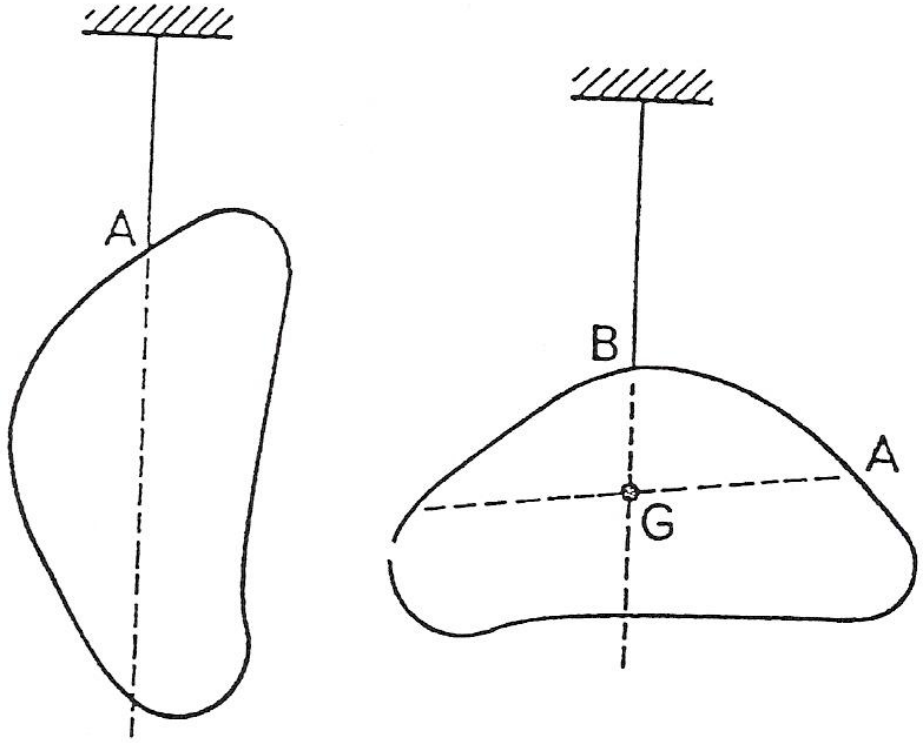


Figure 4 - Determination of the Centre of Gravity of a Thin Plate by Suspension

It is often possible to determine the position of the centre of gravity by a simple experiment. For instance, Figure 4 shows a thin plate of irregular shape. If the plate is suspended in turn from two points, A and B, and if vertical lines from A and B respectively are drawn as shown dotted in Figure 4, the intersection G of these lines gives the position of the centre of gravity of the plate.

Rectangular plate: c.g. at intersection of diagonals.

Triangular plate: c.g. at intersection of medians or lines joining an apex to the mid-point of the opposite side. It is one-third of the distance from the mid-point towards the apex.

Circular plate: c.g. at centre.

Sphere: c.g. at centre.

Cylinder: c.g. at mid-point of the axis.

Ring: c.g. at centre (which is not in the body of the ring).

Marking Out (Introduction)

The term MARKING-OUT, in general, means the scribing of lines on a metal surface to indicate, for example, a required outline or profile; the outline of any holes or apertures required to be cut; the position of any hole centres; the position of bending or folding lines, and allowances for edge preparations.

Scribing tools, unlike pencils and pens used for drawing, cut into the metal surface producing lines or marks which are reasonably permanent. In order to avoid cutting through the plated surfaces of coated materials such as tinplate, terneplate and galvanised steel, exposing the mild steel base to possible corrosion, a brass scriber or a hard pencil should be used. Prior to marking-out, it may be necessary to prepare the surface of the metal by the application of coating in a contrasting colour so that any scribed line will show up clearly.

Whitewash

The surfaces of steel plate are often covered with a black scale (oxidation) as a result of the hot rolling process during manufacture. On such surfaces it is not easy to distinguish a scribed line, as is the case with the rough surfaces of castings. To overcome this problem the surface to be marked-out is either ‘chalked’ or coated with ‘whitewash’.

The Scribed Line

The choice of tool or instrument and the method of using it for measuring or marking-out are influenced by the degree of accuracy required. In order to produce accurately-dimensioned finely-defined scribed lines, it is essential that the scribing points of scribers, dividers or compasses, trammels and surface gauges be maintained in needle sharp condition.

General Precautions to be Observed with the use of Cranes

The hazards and potential dangers that could arise when lifting heavy loads with cranes, hoists and fork-lift trucks or any movement of materials by mechanical means cannot be over emphasised. In this section some of the hazards arising from the use of mobile cranes will be outlined in the following precautionary measures:

1. Loads should only be lifted vertically. It is a hazard to swing loads out manually to gain additional radius, for in doing so the effect is to extend the length of the jib and throw stresses on the crane for which it was not designed. This effect is shown in Figure 5.

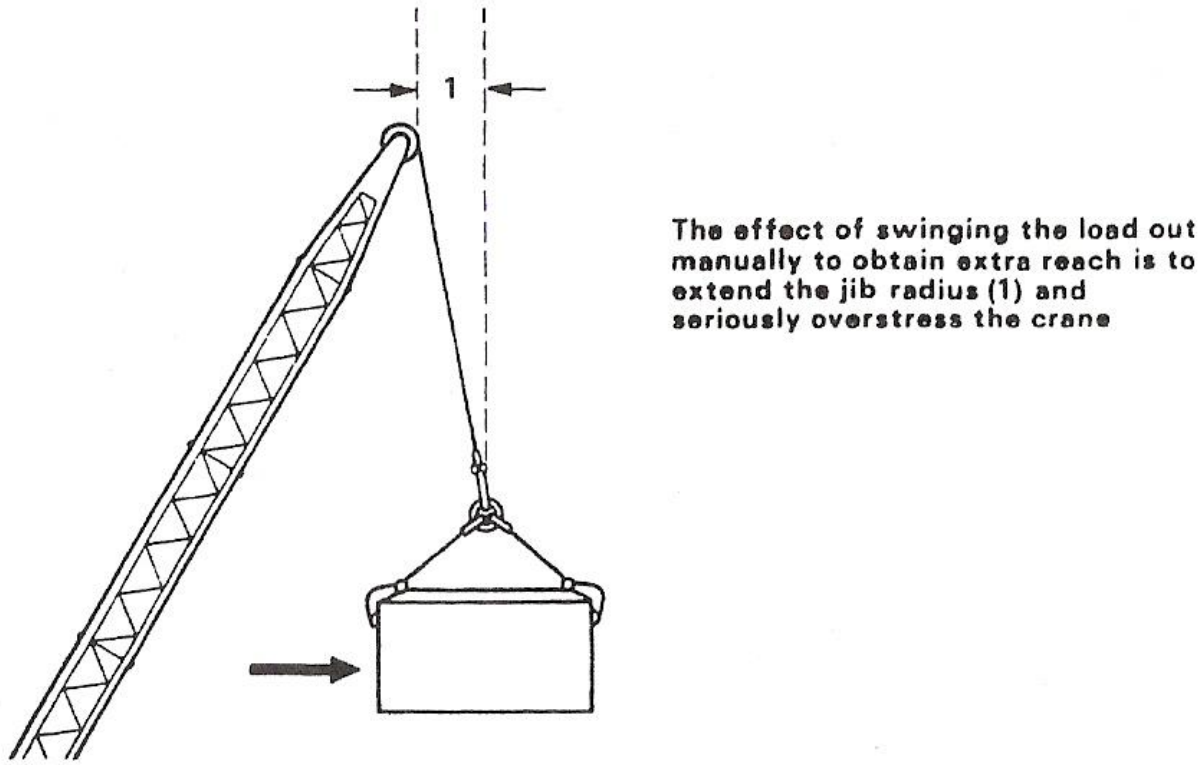


Figure 5 - Effect of Over-Reaching the Jib

2. Loads should always be kept directly and vertically under the lifting point of the jib. Severe overstressing of the jib can be caused by dragging loads inwards or sideways or by moving loads out of the vertical. This effect is indicated in Figure 6.

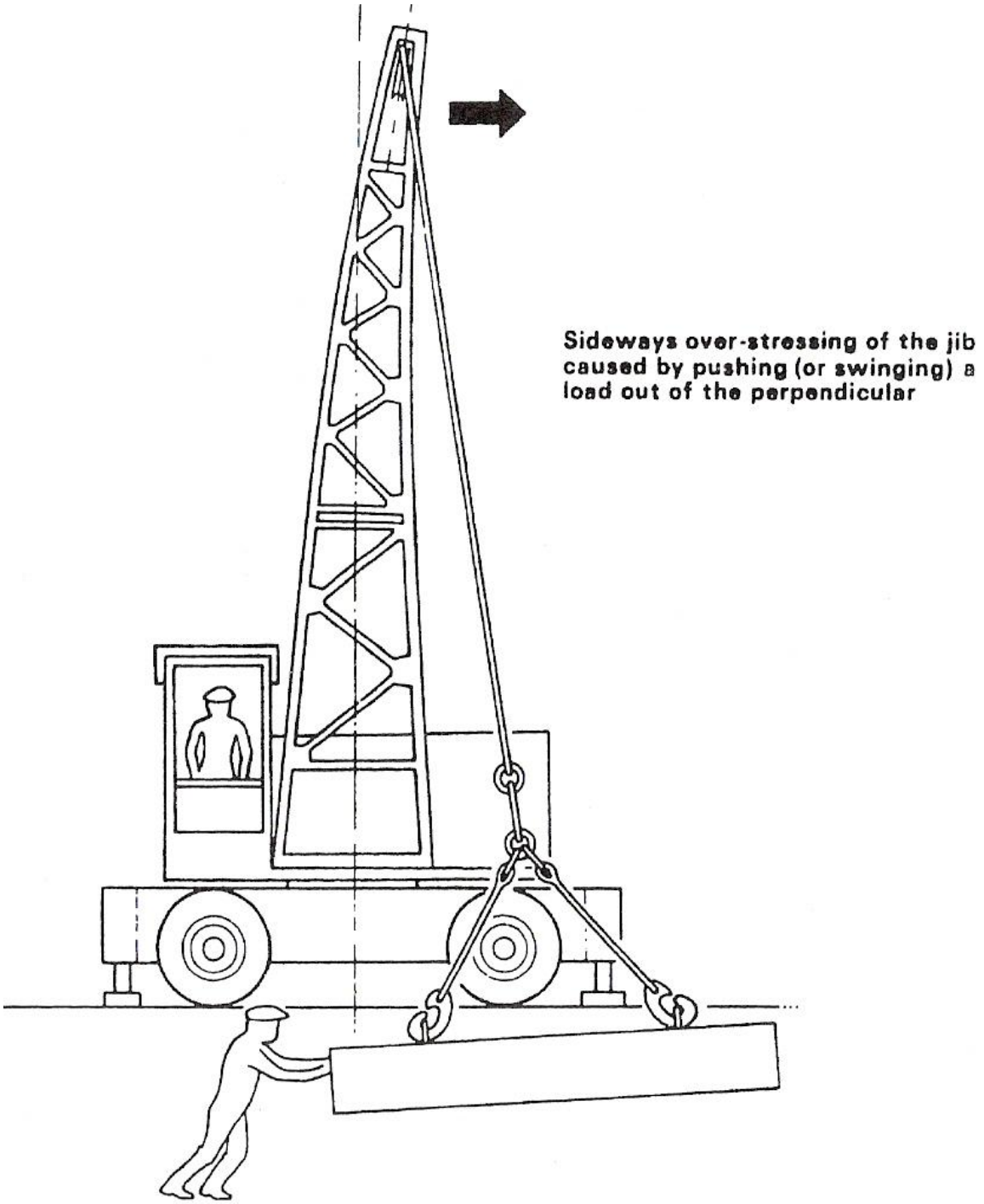


Figure 6 - Effect of Swinging the Load

3. NO PERSON SHOULD STAND UNDERNEATH A LOAD SUSPENDED FROM A LIFTING DEVICE; NEITHER SHOULD A LOAD BE TRAVERSED OVER ANY PERSON.

4. Mobile cranes should not be moved with the jib in near minimum radius.

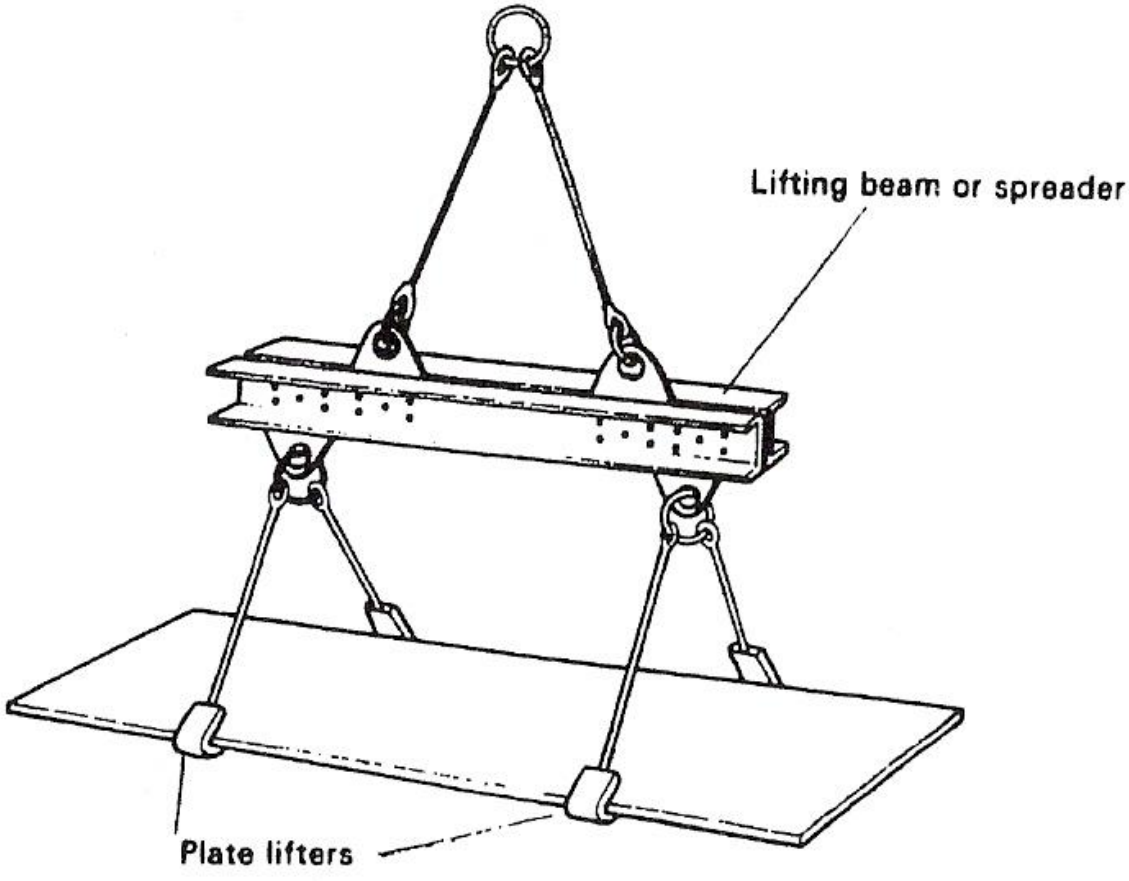


Figure 7 - Use of a Spreader

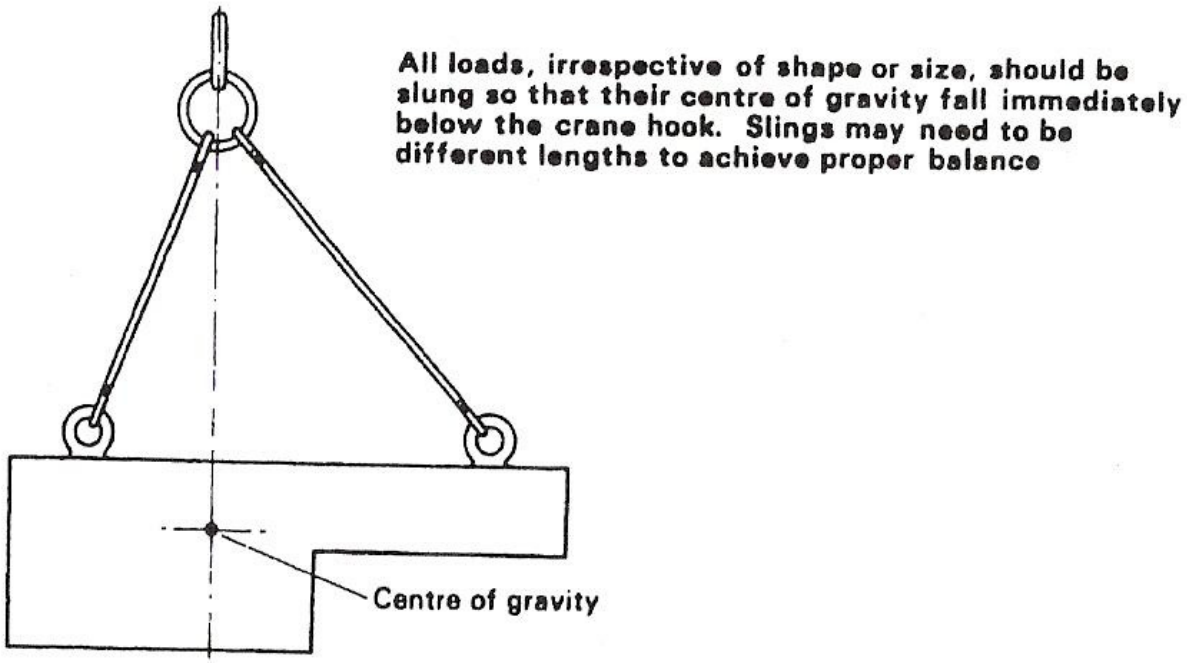


Figure 8 - The Use of Slings

Wire Ropes

Because of their large selection of size, strength, good wearing and handling capacities, wire ropes are virtually indispensable for the erection of constructional steelwork. The use of these ropes with the correct combination of pulley blocks enable a wide range of loads, up to hundreds of tonnes, to be lifted with ease.

Wire ropes used out of doors on erection work are constantly exposed to dampness which causes wear and corrosion. To counteract this, ropes must be frequently examined and greased with a suitable lubricant recommended by the manufacturer. Paraffin or petrol must never be used for cleaning wire ropes.

Because wire ropes are used for all types of mechanically-driven cranes operate at high working speeds, they are liable to have a short working life. Consequently 'Health and Safety at Work' regulations stipulate that routine inspections be carried out at frequent intervals.

Wire Rope Slings

Compared with chain slings, wire rope slings are much lighter, more flexible and easier to handle.

Chain Slings

Chain slings are provided with a ring large enough in diameter to enable it to be used over a hook intended for a larger safe working load. This facilitates, for example, the use of a 1-tonne chain sling on the hook of a 5-tonne crane. They are manufactured from either standard or special grades of wrought iron and the strength of the chain is measured from the diameter of the individual links. The effective length of the chain sling is measured similarly to that of wire rope slings.

Table 1 gives details of Safe Working Loads for chain slings.

Nominal Diameter of Chain (mm)	Permissible Working Load (tonnes)
12.7	1.50
14.0	1.85
16.0	2.30
17.5	2.30
19.0	3.35
21.0	4.00
22.0	4.55
24.0	5.25
27.0	6.00
29.0	7.55
30.0	8.50

Table 1 - Safe Working Loads for Single-Leg Chain Slings

Hooks, rings and shackles, as well as chain and wire rope slings are termed 'lifting tackle'. All lifting tackle must be tested before use and given an identification mark after testing with the S.W.L. clearly shown.

Regulations stipulate that an examination of all lifting tackle must be carried out by a competent examiner every six months. Annealing of all wrought iron lifting tackle must be carried out at regular intervals of fourteen months, with the exception of tackle constructed from bar of 12 mm diameter or less, in this case, the period between annealing is six months.

Hooks

A hook is a vital part of any lifting tackle and a variety of types are available for use with chains and slings. Some have trunnions which allow them to swivel and others are fitted with a safety catch.

The following terminology is used when referring to hooks:

The BILL is the point of a hook;

The SHANK is the body;

The CROWN is the bottom of a hook;

The BACK is that part of the shank opposite the bill;

The JAW is the space between the bill and the top of the shank;

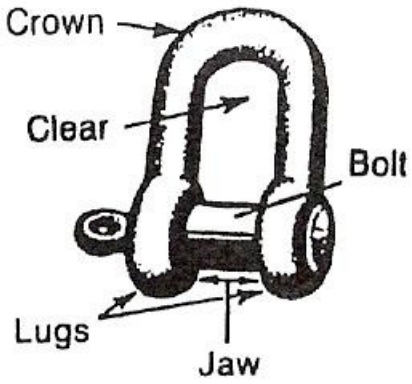
The CLEAR is the inside diameter of the crown.

Shackles

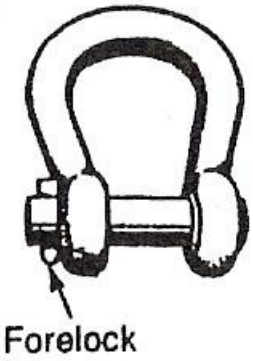
Shackles are couplings used for joining wire ropes and/or chains together or to some fitting. They are usually made of wrought iron or mild steel.

DEE SHACKLES (which are U-shaped and sometimes called 'straight shackles') and BOW SHACKLES (which have curved sides and are weaker than straight ones) are the two common patterns in general use. Both types are available with either large or small jaws and may be described as 'long in the clear' or 'wide in the clear'. The jaw is closed by a removable bolt, called a 'shackle pin', which passes through a hole in each lug. Shackle pins may be of various patterns, the most common having a screw thread at one end and an eye at the other which enables it to be tightened or slackened with a toggle spanner. Other types of pin may have countersunk heads which require the use of a screwdriver. A general purpose shackle is usually named by the manner in which its bolt is secured in place, as illustrated in Figure 10.

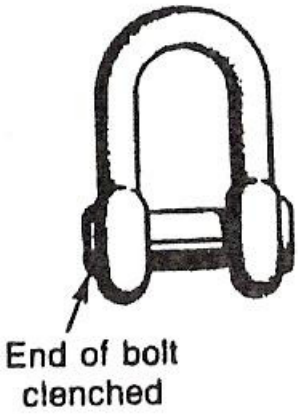
Figure 9 - Lifting Tackle – Hooks



Screw Shackle
The end of the bolt (shackle pin) is screwed into one of the lugs.
The head of the bolt may be flanged or countersunk.
It should be 'moused'.



Forelock Shackle
A flat tapered pin called a 'forelock' is passed through the slot in the end of the bolt, projecting beyond one of the lugs.
The forelock may be attached to the shackle by a keep chain.



Clenched Shackle
The end of the bolt is heated and then hammered over so that it cannot be removed, thus closing it permanently.

Figure 10 - Lifting Tackle – Shackles

Eye Bolts, Eye Plates and Ring Bolts

These are widely used as an aid to lifting and transporting.

EYE PLATES are stamped out of mild steel or wrought iron and are used for securing an eye to a metal structure. They are either riveted or welded in place.

EYE BOLTS are made of mild steel or wrought iron. They may be secured by screwing into a tapped hole or with a nut and washer.

Some types are supplied in pairs which can be cut to length and threaded as and when required.

RING BOLTS are screwed eye bolts with a ring or link attached. Like eye bolts, they are available in pairs as shown in Figure 11.

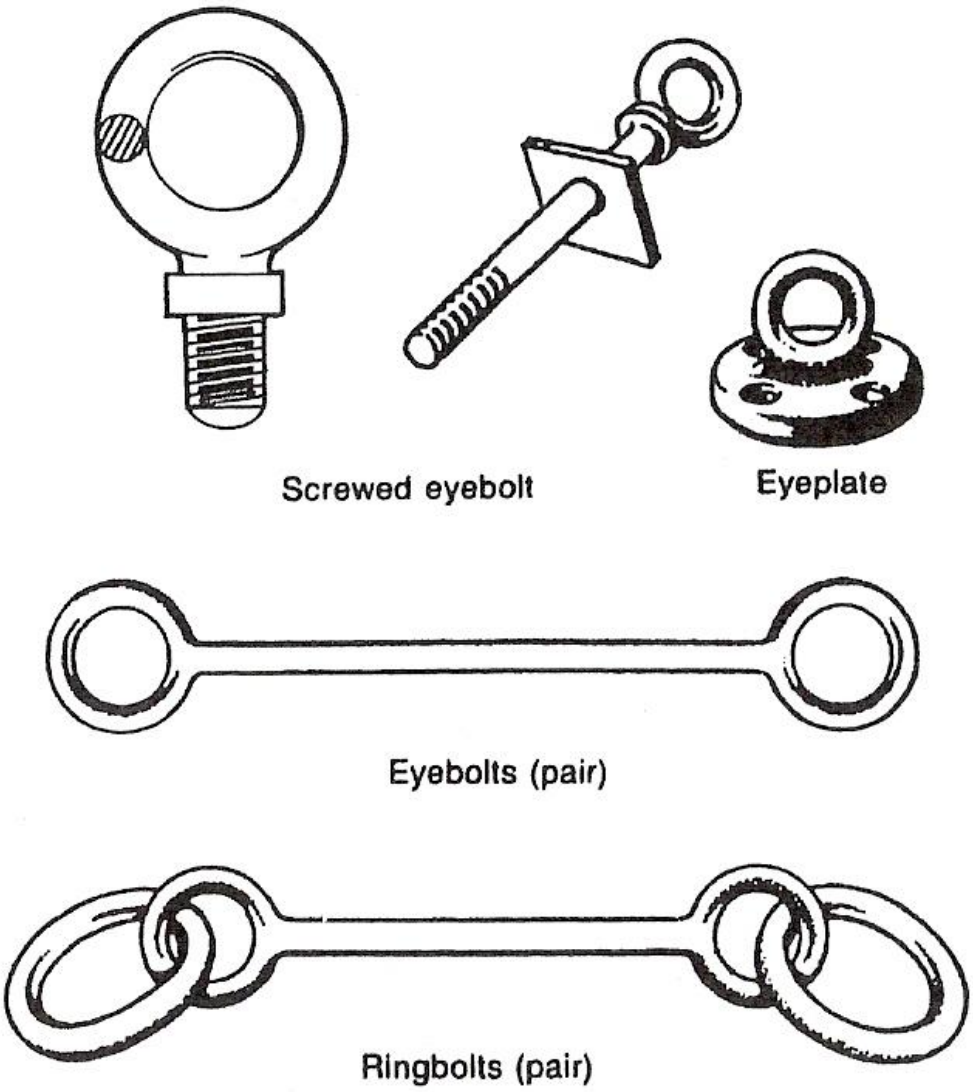


Figure 11 - Lifting Tackle - Eye Bolts, Eye Plates and Ring Bolts

Self Assessment

Questions on Background Notes – Module 3.Unit 7

No Suggested Questions and Answers.

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