

Example 4.8. Two plates 16 mm thick are joined by a double riveted lap joint as shown in Fig. 4.11. The rivets are 25 mm in diameter.

Find the crushing stress induced between the plates and the rivet, if the maximum tensile load on the joint is 48 kN.

Solution. Given : $t = 16 \text{ mm}$; $d = 25 \text{ mm}$;
 $P = 48 \text{ kN} = 48 \times 10^3 \text{ N}$

Since the joint is double riveted, therefore, strength of two rivets in bearing (or crushing) is taken. We know that crushing stress induced between the plates and the rivets,

$$\sigma_c = \frac{P}{d.t.n} = \frac{48 \times 10^3}{25 \times 16 \times 2} = 60 \text{ N/mm}^2 \text{ Ans.}$$

Example 4.9. A journal 25 mm in diameter supported in sliding bearings has a maximum end reaction of 2500 N. Assuming an allowable bearing pressure of 5 N/mm², find the length of the sliding bearing.

Solution. Given : $d = 25 \text{ mm}$; $P = 2500 \text{ N}$; $p_b = 5 \text{ N/mm}^2$

Let $l =$ Length of the sliding bearing in mm.

We know that the projected area of the bearing,

$$A = l \times d = l \times 25 = 25 l \text{ mm}^2$$

∴ Bearing pressure (p_b),

$$5 = \frac{P}{A} = \frac{2500}{25 l} = \frac{100}{l} \quad \text{or} \quad l = \frac{100}{5} = 20 \text{ mm Ans.}$$

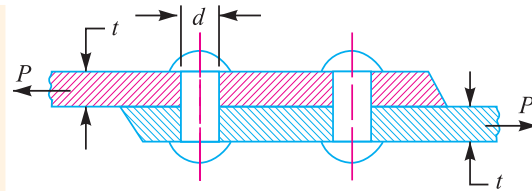


Fig. 4.11

4.11 Stress-strain Diagram

In designing various parts of a machine, it is necessary to know how the material will function in service. For this, certain characteristics or properties of the material should be known. The mechanical properties mostly used in mechanical engineering practice are commonly determined from a standard tensile test. This test consists of gradually loading a standard specimen of a material and noting the corresponding values of load and elongation until the specimen fractures. The load is applied and measured by a testing machine. The stress is determined by dividing the load values by the original cross-sectional area of the specimen. The elongation is measured by determining the amounts that two reference points on the specimen are moved apart by the action of the machine. The original distance between the two reference points is known as **gauge length**. The strain is determined by dividing the elongation values by the gauge length.

The values of the stress and corresponding strain are used to draw the stress-strain diagram of the material tested. A stress-strain diagram for a mild steel under tensile test is shown in Fig. 4.12 (a). The various properties of the material are discussed below :



In addition to bearing the stresses, some machine parts are made of stainless steel to make them corrosion resistant.

Note : This picture is given as additional information and is not a direct example of the current chapter.

1. Proportional limit. We see from the diagram that from point *O* to *A* is a straight line, which represents that the stress is proportional to strain. Beyond point *A*, the curve slightly deviates from the straight line. It is thus obvious, that Hooke's law holds good up to point *A* and it is known as **proportional limit**. It is defined as that stress at which the stress-strain curve begins to deviate from the straight line.

2. Elastic limit. It may be noted that even if the load is increased beyond point *A* upto the point *B*, the material will regain its shape and size when the load is removed. This means that the material has elastic properties up to the point *B*. This point is known as **elastic limit**. It is defined as the stress developed in the material without any permanent set.

Note: Since the above two limits are very close to each other, therefore, for all practical purposes these are taken to be equal.

3. Yield point. If the material is stressed beyond point *B*, the plastic stage will reach *i.e.* on the removal of the load, the material will not be able to recover its original size and shape. A little consideration will show that beyond point *B*, the strain increases at a faster rate with any increase in the stress until the point *C* is reached. At this point, the material yields before the load and there is an appreciable strain without any increase in stress. In case of mild steel, it will be seen that a small load drops to *D*, immediately after yielding commences. Hence there are two yield points *C* and *D*. The points *C* and *D* are called the **upper** and **lower yield points** respectively. The stress corresponding to yield point is known as **yield point stress**.

4. Ultimate stress. At *D*, the specimen regains some strength and higher values of stresses are required for higher strains, than those between *A* and *D*. The stress (or load) goes on increasing till the

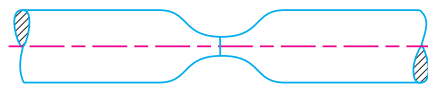
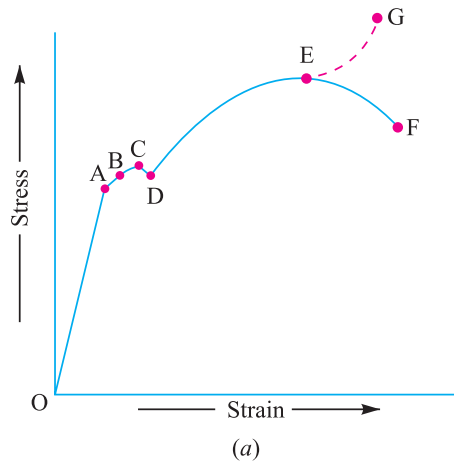


Fig. 4.12. Stress-strain diagram for a mild steel.



A crane used on a ship.

Note : This picture is given as additional information and is not a direct example of the current chapter.