Step III *Permissible stress amplitude*

The co-ordinates of the point C (S_m, S_a) are obtained by solving the following two equations simultaneously:

$$\frac{S_m}{780} + \frac{S_a}{86.67} = 1 \qquad \text{(a)}$$

$$S_m = \frac{P_i}{A} + S_a = \frac{34\,361.17}{A} + S_a \qquad \text{(b)}$$

where A is tensile stress area of the bolt.

The solution is obtained by Eq. (7.30).

From Eq. (7.30),

$$S_a = \frac{S_{ut} - (P_i/A)}{1 + (S_{ut}/S_e)} = \frac{780 - (34\,361.17/A)}{1 + (780/86.67)}$$

$$= \frac{780 - (34\,361.17/A)}{10}$$

Step IV *Size of bolt*

Since $\sigma_a = \frac{S_a}{(fs)} \qquad \therefore \frac{P_a}{A} = \frac{S_a}{(fs)}$

or $$\frac{1202.64}{A} = \frac{1}{2}\left[\frac{780 - (34361.17/A)}{10}\right]$$

$$\frac{1202.64}{A} = 39 - \frac{1718.06}{A}$$

or $$\frac{2920.7}{A} = 39$$

$A = 74.89 \text{ mm}^2$

From Table 7.2, bolts with fine threads M12 × 1.5 ($A = 88.1 \text{ mm}^2$) are suitable for this application.

Short-Answer Questions

7.1 What is threaded joint?
7.2 What are the advantages of threaded joints?
7.3 What are the disadvantages of threaded joints?
7.4 What is a through bolt?
7.5 What is a machine bolt?
7.6 What is an automobile bolt?
7.7 What is a tap bolt?
7.8 What is a cap screw?
7.9 When do you use tap bolts and cap screw?
7.10 What is a stud?
7.11 Why is hexagonal head preferred for cap screw instead of square head?
7.12 What is a setscrew?
7.13 What is bolt of uniform strength?
7.14 What are the methods of preventing loosening of threads between the nut and the screw?
7.15 What is lock nut? What is the principle of lock nut?
7.16 What is a castle nut? Why is it called castle nut?
7.17 What is a split pin?
7.18 How is locking of threads obtained in castle nut?
7.19 What is a split nut?
7.20 How is locking of threads obtained in split nut?
7.21 What is nominal diameter of screw thread?
7.22 What is root diameter of screw thread?
7.23 What is pitch diameter of screw thread?
7.24 What is pitch of screw thread?
7.25 What is lead of screw thread?
7.26 What is thread angle of screw thread?
7.27 What is magnitude of thread angle of ISO metric thread?
7.28 What is tensile stress area of screw thread?
7.29 What are the advantages of coarse threads?
7.30 What are the advantages of fine threads?
7.31 What are the applications of coarse threads?
7.32 What are the applications of fine threads?
7.33 How will you designate ISO metric coarse threads?
7.34 How will you designate ISO metric fine threads?
7.35 What do you understand by 'hard' and 'soft' gaskets?

Problems for Practice

7.1 A gearbox weighing 7.5 kN is provided with a steel eye bolt for lifting and transporting on the shop-floor. The eyebolt is made of plain carbon steel 30C8 ($S_{yt} = 400 \text{ N/mm}^2$) and the factor of safety is 5. Determine the nominal diameter of the eye bolt having coarse threads if,

$$d_c = 0.8d$$

where d_c and d are core and major diameters respectively.

[*13.66 mm*]

7.2 A steam engine cylinder has an effective diameter of 250 mm. It is subjected to a

maximum steam pressure of 1.5 MPa (1.5 N/mm^2). The cylinder cover is fixed to the cylinder flange by means of 12 studs. The pitch circle diameter of the studs is 400 mm. The permissible tensile stress in the studs is limited to 30 N/mm^2.

(i) Determine the nominal diameter of the studs if $d_c = 0.84d$.

(ii) Calculate the circumferential pitch of the studs. Is it satisfactory?

[*(i) 19.21 mm (ii) 104.72 mm, between 5d to 10d*]

7.3 A steel plate subjected to a force of 3 kN and fixed to a vertical channel by means of four identical bolts is shown in Fig. 7.49. The bolts are made of plain carbon steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 2. Determine the diameter of the shank.

[*6.58 mm*]

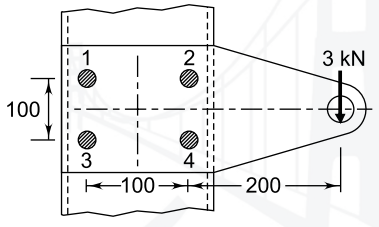

Fig. 7.49

7.4 A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in Fig. 7.50. The bolts are made of plain carbon steel 30C8 (S_{yt} = 400 N/mm^2) and the factor of safety is 3. Determine the diameter of the shank.

[*12.74 mm*]

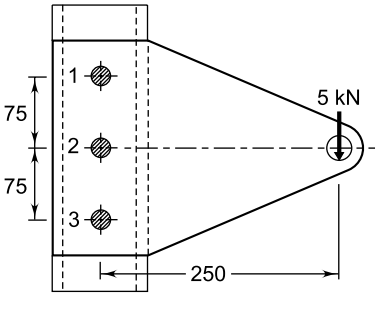

Fig. 7.50

7.5 A bracket for supporting the travelling crane is shown in Fig. 7.51. The bracket is fixed to the steel column by means of four identical bolts, two at *A* and two at *B*. The maximum load that comes on the bracket is 5 kN acting vertically downward at a distance of 250 mm from the face of the column. The bolts are made of steel 40C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 5. Determine the major diameter of the bolts on the basis of maximum principal stress. Assume (d_c = 0.8d)

[*7.74 mm*]

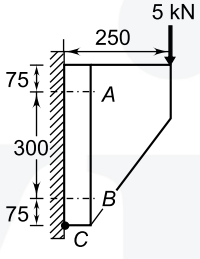

Fig. 7.51

7.6 A cast iron bracket, as shown in Fig. 7.52, supports a load of 10 kN. It is fixed to the horizontal channel by means of four identical bolts, two at *A* and two at *B*. The bolts are made of steel 30C8 (S_{yt} = 400 N/mm^2) and the factor of safety is 6. Determine the major diameter of the bolts if (d_c = 0.8d).

[*17.73 mm*]

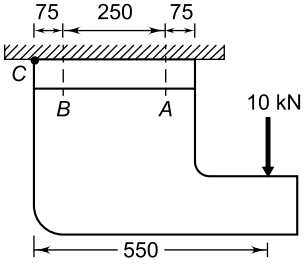

Fig. 7.52

7.7 Assume the following data for the cast iron bracket shown in Fig. 7.25(a).

l_1 = 75 mm $\quad$ l_2 = 225 mm

l = 300 mm $\quad$ P = 10 kN