

Questions for Practice in Machine Design
(For Forth Semester Engineering Students)

PART II

Q.1. A machine frame is made of steel. When the machine frame is loaded in a test fixture, stresses were found to vary linearly with load. Two points A and B on the surface are found to be most critical. With 4kN test load, stresses at point A and point B are given below.

Point A: $\sigma_1 = 200 \text{ MPa}$ $\sigma_2 = 100 \text{ MPa}$ $\sigma_3 = \text{Zero}$

Point B: $\sigma_1 = 150 \text{ MPa}$ $\sigma_2 = -100 \text{ MPa}$ $\sigma_3 = \text{Zero}$

Compute the test load at which the machine frame will experience initial yielding. Also find out the location where the initial yielding will begin. Give your comment on the results you have computed.

Properties of steel: $\sigma_{\text{yield}} = \pm 400 \text{ MPa}$ $\tau_{\text{yield}} = \pm 250 \text{ MPa}$ $\sigma_{\text{ultimate}} = \pm 780 \text{ MPa}$

Q.2. A round steel bar is subjected to loads which produce calculated tensile stress of 70MPa, calculated maximum torsional shear stress of 200MPa, calculated maximum bending stress of 300MPa and calculated maximum transverse shear stress of 170MPa while acting individually. Determine the factor of safety with respect to initial yielding. Give your comment on the value of factor safety you have computed.

Properties of steel: $\sigma_{\text{yield}} = \pm 450 \text{ MPa}$ $\sigma_{\text{ultimate}} = \pm 875 \text{ MPa}$

Q.3. Design and draw a complete knuckle joint that will carry a tensile load of 35 kN. The knuckle joint will be made of steel 30C8. Use a factor of safety of 6 for eye and fork of knuckle joint and a factor of safety of 4 for knuckle pin. The yield strength of steel 30C8 may be assumed as 400 MPa.

Q.4. Design and draw a complete knuckle joint that will carry a tensile load of 35 kN. The knuckle joint will be made of steel 30C8. Use a factor of safety of 6 for eye and fork of knuckle joint and a factor of safety of 4 for knuckle pin. The yield strength of steel 30C8 may be assumed as 400 MPa.