

QUESTION 1

A tensile test is carried out on a steel rod. The test piece has a diameter of 20 mm and is gauged to a length of 85 mm.

The following results were obtained during the test:

- Load at the limit of proportionality: 72 kN
- Change in length at the limit of proportionality: 110 μm
- Load at yield point: 90 kN
- Maximum load: 145 kN
- Load at point of fracture: 80 kN
- Total extension: 21 mm
- Diameter after fracture: 8,6 mm

1.1 Calculate each of the following:

- 1.1.1 Stress at the limit of proportionality
- 1.1.2 Young's modulus of elasticity of the steel
- 1.1.3 Yield stress
- 1.1.4 Tensile strength
- 1.1.5 Stress at fracture
- 1.1.6 Percentage elongation
- 1.1.7 Percentage reduction in area

(7 × 2) (14)

1.2 Draw a stress-strain curve containing all the relevant points that the material of a test piece will undergo during a typical tensile test. (6)

[20]

QUESTION 2

A cylindrical pressure vessel is pressurised to 1,2 MPa. The vessel is 2,5 m long and has a wall thickness of 10 mm. The inside diameter of the drum is 1,2 m. During the testing of the vessel, the longitudinal and circumferential stresses are measured to be 36 MPa and 72 MPa respectively.

2.1 Calculate each of the following:

2.1.1 Force acting on the circumferential joint

2.1.2 Resistance force for the circumferential joint

2.1.3 Force acting on the longitudinal joint

2.1.4 Resistance force for the longitudinal joint

(4 × 2) (8)

2.2 Draw the TWO sketches of a cylindrical pressure vessel and indicate the forces acting and resisting on the longitudinal joint and the circumferential joint.

(4)

[12]

QUESTION 3

A compound shaft consists of a solid steel rod fitted into a bronze sleeve. The bronze sleeve with an inside diameter of 48 mm is shrunk onto a steel shaft. The torque carried by the solid shaft is 1/3 times the torque carried by the bronze sleeve. The modulus of rigidity (G) for steel is 2,2 times the G for bronze.

MATERIAL	ALLOWABLE TORSIONAL (SHEAR) STRESSES
Steel	84 MPa
Bronze	46 MPa

MATERIAL DATA

Calculate each of the following:

3.1 Outside diameter of the bronze sleeve

(7)

3.2 Torque transmitted by the shaft

(4)

3.3 Power transmitted by the shaft at 388 r/min

(2)

[13]

TOTAL : 45