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MSC Assignment - 1

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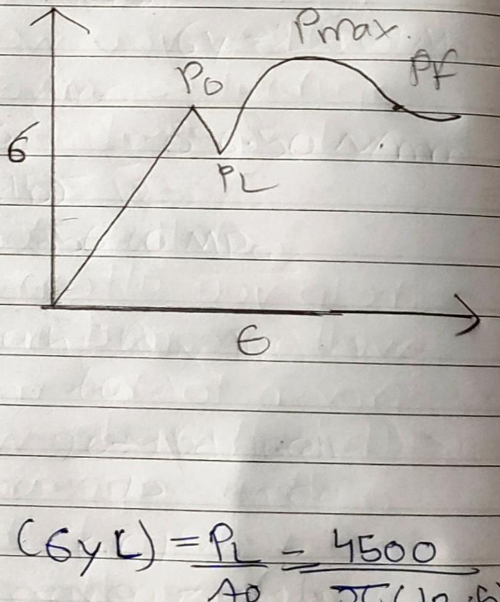
Q1.) Tensile test conducted on steel specimen of diameter 12.5mm & gauge length 50mm loads at upper & lower yield points were 4600 & 4500 respectively. Max & fracture loads were 7500 kg & 5000kg Gauge length after fracture was 62.5mm, diameter of fracture place was 8mm.

Find- ① lower yield stress
② upper yield stress
③ Ultimate tensile stress
④ fracture stress
⑤ True facture stress
⑥ percent elongation
⑦ Percent reduction in crosssection area.

Ans→ $P_L = 4500$ kg
$P_U = 4600$ kg
$P_{max} = 7500$ kg
$P_F = 5000$ kg
$d_0 = 12.5$ mm



Given: $A_0 = \frac{\pi}{4} d_0^2$

$A_f = \frac{\pi}{4} d_f^2$

① ∴ Lower yield strength $(\sigma_{yL}) = \frac{P_L}{A_0} = \frac{4500}{\frac{\pi}{4}(12.5)^2}$

$= 36.66$ kg/mm^2
$= 366.69$ N/mm^2
$= 366.69$ MPa

(2) Upper yield stress (σ_{yu}) $= \frac{P_u}{A_0} = \frac{4600}{\pi/4 (12.5)^2}$

$= 37.48 \ kg/mm^2$

$= 374.8 \ N/mm^2$

$= 374.8 \ N/10^{-6} m^2$

$= 374.8 \times 10^6 \ N/m^2$

$\boxed{\sigma_{yu} = 374.8 \ MP}$

(3) Ultimate tensile stress (σ_{UTS}) $= \frac{P_{max}}{A_0} = \frac{7500}{\frac{\pi}{4}(12.5)^2}$

$= 61.11 \ kg/mm^2$

$\sigma_{UTS} = 611.1 \ MPa$

(4) Fracture stress (σ_{fTS}) $= \frac{P_f}{A_0} = \frac{5000}{\pi/4 (12.5)^2}$

$= 40.74 \ kg/mm^2$

$\sigma_f = 407.4 \ MPa$

(5) True fracture stress (σ_{ftrue}) $= \frac{P_f}{A_f} = \frac{5000}{\pi/4 (8)^2}$

$= 99.47 \ kg/mm^2$

$\sigma_{ftrue} = 994.7 \ MPa$

(6) Percent elongation $= \left(\frac{62.5 - 50}{50}\right) \times 100$

$= 25\%$

(7) Percent reduction in crosssection area.

$= \left(\frac{A_0 - A_f}{A_0}\right) \times 100 = 59.04\%$

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Q2) A test rod of 15mm diameter failed at 50kN driving tensile test but reached max load of 63 kN. The specimen had 75 mm gauge length and yielding at 45kN and was elongated to 80mm.
Calculate a. Yield stress b. Ultimate tensile stress c. % Elongation.

Ans→ Given - $P_f = 50kN$
$P_{max} = 63kN$
$l_0 = 75mm$; $L_f = 80mm$
$P_y = 45kN$, $d_0 = 15mm$

a) $\sigma_{yield} = \frac{P_y}{A_0} = \frac{P_y}{\frac{\pi}{4} d_0^2} = \frac{45\times10^3}{\pi/4 (15)^2} = 254.64\ N/mm^2$

$\sigma_y = 254.64\ MPa$

b) $\sigma_{uts} = \frac{P_{max}}{A_0} = \frac{63\times10^3}{\pi/4 \times (15)^2} = 356.50\ N/mm^2$

$\sigma_{uts} = 356.60\ MPa$

c) Percentage elongation $= \frac{l_f - l_0}{l_0} \times 100$

$= \frac{80-75}{75} \times 100$

$= 6.67\%$

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Q33) A 20 cm long rod w/a diameter of 0.30cm is loaded with 400N. If diameter revolves to 0.27cm. find - (1) Engineering stress
(2) True stress

Ans→ $L_0 = 20cm$
$d_0 = 0.30 cm = 3mm$, $d_f = 0.27cm = 2.7mm$
$L = 4000N$

(1) Engineering stess = $\frac{\text{load}}{\text{original area}} = \frac{4000}{\pi/4 (d_0)^2}$
$= 565.884 \, N/mm^2$
$\sigma_{eng} = 565.88 MPa$

(2) True stress = $\frac{\text{load}}{\text{new area}} = \frac{4000}{\pi/4 (d_f)^2}$
$= 698.622 \, N/mm^2$
$= 698.622 \times 10^6 \, N/m^2$
$\sigma_{true} = 698.622 MPa$

Q34) The tensile test specimen of mild steel of 8mm diameter & 40mm gauge length was tested with following result
$L_{max} = 3212 kg$, $L_y = 1750 kg$, $\Delta l = 50mm$, $d_f = 5.4mm$.

Find - (1) UTS in kg/mm^2
(2) Y.S in kg/mm^2
(3) % elongation.
(4) % reduction in area.

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Ans→ $d_0 = 8mm$, $d_f = 5.4mm$
$L_0 = 40mm$, $\Delta l = 50mm$
$L_{max} = 3212 kg$; $L_y = 1750 kg$

① $UTS = \frac{L_{max}}{A_0} = \frac{3212}{\pi/4 (d_0)}$

$UTS = 63.90 \ kg/mm^2$

② $Y.S = \frac{L_y}{A_0} = \frac{1750}{\pi/4 (d_0)^2} = 34.815$

$YS = 34.815 kg/mm^2$

③ % elongation $= \frac{\Delta l}{l_0} \times 100$

$= \frac{50}{40} \times 100$

% elongation = 125%

④ % reduction in area $= \left(\frac{A_0 - A_F}{A_0}\right) \times 100$

$= \frac{\pi/4 (d_0^2 - d_f^2)}{\pi/4 \, d_0^2} \times 100$

% reduction in area = 54.43%

Q35) Following data was obtained during tensile test conducted on mild steel specimen 42mm in diameter & 210mm long.

ΔL with 45 kN = 0.404 mm
L_y = 163 kN, L_{max} = 245 kN, L_f = 250 mm
find - ① Young's modulus
② Yield point
③ ultimate stress
④ Percentage elongation.

Ans-> $L_0 = 210$ mm, $L_f = 250$ mm, ΔL at 45 kN = 0.404 mm
$L_y = 163$ kN, $L_{max} = 245$ kN, $d_0 = 42$ mm.

① Youngs modulus
stress $\sigma = \frac{P}{A} = \frac{40}{\pi/4 \, d_0^2} = 0.0289 \ kN/mm^2$
$= 0.0289 \times 10^6 \ kN/m^2$
$= 289 \times 10^4 \ kN/m^2$

strain $= \frac{\Delta l}{L_0} = \frac{0.404}{210} = 1.92 \times 10^{-3}$

Youngs modulus $E = \frac{stress}{strain} = \frac{2.89 \times 10^4}{192 \times 10^{-3}}$

Youngs modulus $= 1.505 \times 10^7 \ kN/m^2$

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(2) $\sigma_{yp} = \frac{L_y}{A_0} = \frac{163}{\pi/4 \, d_0^2}$

$= 0.11765 \, kN/mm^2$

$= 1.1765 \times 10^5 \, kN/m^2$

$= 1.1765 \times 10^6 \, N/m^2$

$\sigma_{yp} = 1.1765 \times 10^2 \, MPa$

$= 117.65 \, MPa$

(3) $\sigma_{UTS} = \frac{L_{max}}{A_0} = \frac{245}{\pi/4 \, d_0^2}$

$= 0.17683 \, kN/mm^2$

$= 1.7683 \times 10^5 \, kN/m^2$

$= 1.7683 \times 10^8 \, N/m^2$

$= 176.83 \times 10^6 \, N/m^2$

$\sigma_{UTS} = 176.83 \, MPa$

(4) % elongation $= \frac{L_f - L_0}{L_0} \times 100$

$= \frac{40}{210} \times 100$

$\Rightarrow$ % elongation $= 19.04\%$