CVL3211 : Quiz 1 Solution
Section A

Q.1 a In Figure 1, Y-axis and X-axis denotes σ_A/σ_Y and number of load cycle (n) respectively. Find σ_A for n=250 and endurance limit if $\sigma_Y = 250MPa$.

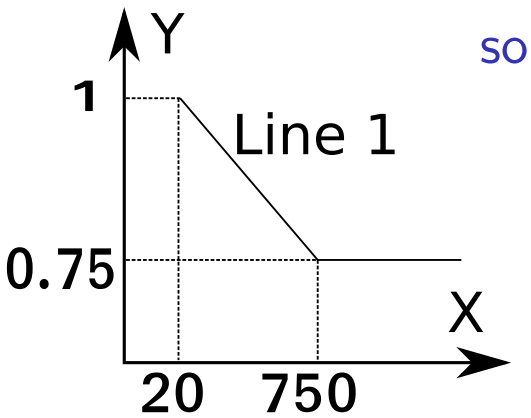

Figure: 1

solution Equation of the Line 1:
$y = mx + c$ for $(x, y) \equiv (20, 1), (750, 0.75)$
Putting these points in equation,
$1 = 20m + c$ and $0.75 = 750m + c$
from these we get, $m = -1/2920, c = 147/146$
and X-axis is n and Y-axis is σ_A/σ_Y
we can write, $\sigma_A/\sigma_Y = -n/2920 + 147/146 \equiv$
$\sigma_A = \sigma_Y(-n/2920 + 147/146)$
finding σ_A at n = 250 and n = 750 (endurance limit) with $\sigma_Y = 250MPa$

answer $\sigma_{A_{250}} = 230.30MPa$ and $\sigma_{A_{750}} = 187.5MPa$

Q.1 b For Figure 2, find Yield stress from offset method.

solution Offset method : draw line with slope equals to Young's modulus (E) from $\epsilon = 0.2\%$ to cut stress-strain curve at yield point.

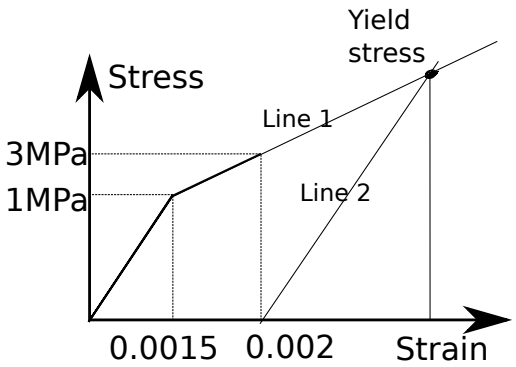

Figure: 1

Slope of line 2 = slope of curve till elastic limit = Young's modulus (E) = 1MPa/0.0015 = 666.67MPa

equation of line 2: $y = mx + c$

m=E and passing through (0.002,0) so

$c = -0.002 \times 1GPa = -2MPa$

Slope of line 1 = slope of elastoplastic part= (3-1)MPa/(0.002-0.0015) =4GPa

Here slope of elastoplastic part is greater than elastic part, hence line 1 and line 2 will never meet $\sigma_Y = \infty$

Q.1 c Find modulus of resilience and toughness for Figure 2.

solution Modulus of resilience and toughness both should be ∞ but for numerical's sake Modulus of resilience can be calculated as $0.5 \times 1MPa \times 0.0015 = 4.5KPa$

Commentary

1. In part(a) of this question, first point from where the graph starts is given as (20,1). That means at $\sigma_A/\sigma_Y = 1$, number of cycles before breakage = 20. Physically that means a cyclic load equals to yield stress is applied 20 times till material fatigues (yields). That is a straight flaw and not possible. But still numerical is treated as a purely mathematical problem.
2. In part (b) and (c) the material given shows abnormal behavior as slope of elastic part is less than slope of elastoplastic part. Similar to first part here marking will also be based on numerical approach.

Q.2 a Cement A has more C_3A content than cement B. Assuming only hydration of C_3A, which will have more initial setting time? Explain.

solution Cement B will set slow or have more IST. C_3A reacts fastest to water of all constituents. hence more C_3A will cause quick set or initial set fast.

b Cement A passes 6% and Cement B passes 15% from $IS90\mu$ sieve. Which of two will have faster rate of hydration? Explain.

solution Cement B is finer as seen in question. Finer the particles more is the surface area and more will be the rate of hydration.

c Write down a compound which contributes least to cement composition and its positive effect on cement.

solution C_4AF contributes least to cement composition and it plays major part in cement's sulphate resistance capability.