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 $\sigma_Y = 250MPa$.

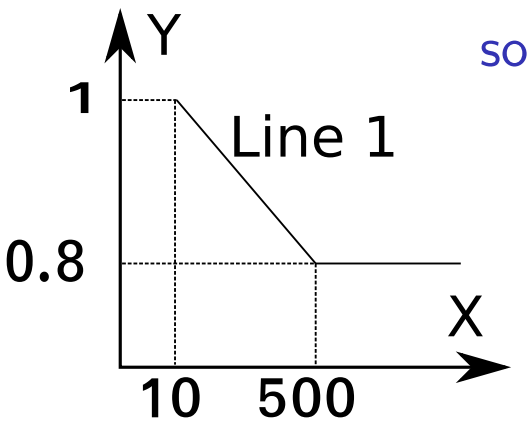

Figure: 1

solution Equation of the Line 1:
$y = mx + c$ for $(x, y) \equiv (10, 1), (500, 0.8)$
Putting these points in equation,
$1 = 10m + c$ and $0.8 = 500m + c$
from these we get, $m = -1/2450, c = 246/245$
and X-axis is n and Y-axis is σ_A/σ_Y
we can write, $\sigma_A/\sigma_Y = -n/2450 + 246/245 \equiv$
$\sigma_A = \sigma_Y(-n/2450 + 246/245)$
finding σ_A at n = 250 and n = 500 (endurance limit) with $\sigma_Y = 250MPa$

answer $\sigma_{A_{250}} = 225.51MPa$ and $\sigma_{A_{500}} = 200MPa$

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

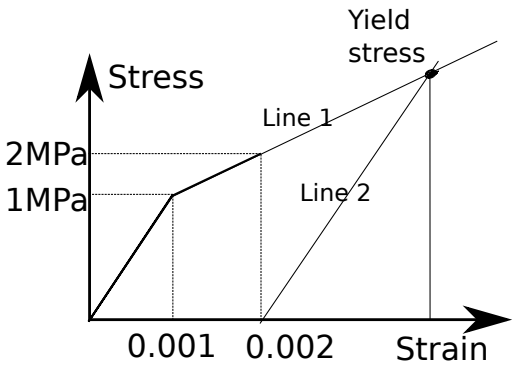

Figure: 1

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.
Slope of line 2 = slope of curve till elastic limit = Young's modulus (E) = 1MPa/0.001=1GPa
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= (2-1)MPa/(0.002-0.001)=1GPa
So material is perfectly elastic.
Graph shows loading till 2MPa so $\sigma_Y = 2MPa$

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

solution Modulus of resilience will be equal to toughness for above case (perfectly elastic) which will be equal to
$0.5 \times 2MPa \times 0.002 = 2KPa$

Commentary

1. In part(a) of this question, first point from where the graph starts is given as (10,1). That means at $\sigma_A/\sigma_Y = 1$, number of cycles before breakage $= 10$. Physically that means a cyclic load equals to yield stress is applied 10 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 will be judged on he base of its loading limit.

Q.2 a Cement A has more C_2S content than cement B. Assuming both have same final setting time, which will have more gypsum requirement?Explain.

solution C_2S affects long term or ultimate strength so more C_2S will cause delay in setting time. Cement A has more C_2S so it won't need more gypsum. Cement B will need retardation in setting hence more gypsum.

b Which property of cement is affected by unreacted CaO present in it? How is it measured in laboratory?

solution Expansion and Sulphate resistance are affected by unreacted CaO in cement. Expansion is measured as soundness by Le-chatelier's apparatus. If the sample expands more than $5mm$ then cement is said to be unsound.

c How does fly ash affect workability of cement? Explain.

solution Fly ash increases workability of cement or concrete. Fly ash is very fine and reduces void ratio and water requirement. It is almost spherical in shape and creates lubrication between cement particles and increase workability.