Department of Civil Engineering
Institute of Technical Education & Research, SOA University

Mid-Semester Examination Solutions, October-2016
Civil Engineering Materials (CVL3211)

Semester: 5^{th} Branch: Civil Engineering
Full mark: 30 Time: 2 Hours

All questions carry equal marks. All bits of each question carry equal marks.

Q.1 Solutions

a First point from where the graph starts is given as (20,1). That means at σ_a/σ_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.

b Extension method : draw line with slope ∞ from $\epsilon = 0.5\%$ to cut stress-strain curve at yield point.
Equation of line 1 = $y = mx + c$
m=slope of elastoplastic part of curve = (1.2-1)MPa/(0.0025-0.0015) =200MPa
$c = y - mx$ with $(x, y) \equiv (1, 0.0015)$ $1MPa - 0.0015 \times 200MPa = 0.7MPa$
Yield stress = Stress at $\epsilon = 0.005$
Yield stress = 1.7MPa

c Modulus of resilience = $0.5 \times 1MPa \times 0.0015 = 0.75KPa$

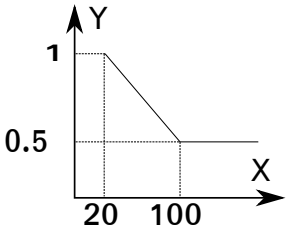

Figure 1: σ_a/σ_y-n curve

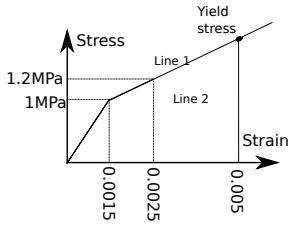

Figure 2: Stress-strain curve

Q.2 Solutions

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

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

Q.3 Solutions

a 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 C_2S.

b 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 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.

Q.4 **Solutions**

a Cube compression failing load = $675KN$
Area of compression cube under stress = $15 \times 15cm^2$
Assuming a single test, compressive strength = Load/Area = $675KN/225cm^2 = 30MPa$

b If another concrete cube fails at $450KN$ hence assuming it contained lesser cementing material or more voids. In any case weaker cube will contain lesser cement so lesser curing time will be needed. Opposite is true for stronger cube.

c Another cube tested at $495KN$. Assuming the group as population, average load is $(675 + 450 + 495)/3 = 540KN$
Standard deviation = $\sqrt{((540-675)^2 + (540-450)^2 + (540-495)^2)/3} = 97.21KN$
Dividing both by areas, $\mu = 540KN/225cm^2 = 24MPa$
$\sigma = 97.21KN/225cm^2 = 4.32MPa$

Q.5 **Solutions**

a Volume of cube for compressive strength test of concrete = $15 \times 15 \times 15cm^3 = 3375cm^3$.
Air content of concrete mix = 3%
Volume of concrete minus air in test cube = $3375-(3375\times3)/100cm^3 = 3273.75cm^3$

b Let us assume weight of cement be x, for M15 (1:2:4)

	Cement	**Sand**	**Coarse aggregates**
Weight (Kg)	x	$2x$	$4x$
Density (gm/cc)	3	2.5	2.6
Volume ($m^3 \times 10^{-3}$)	$x/3$	$2x/2.5$	$4x/2.6$

Volume of water = $0.5x$ Volume balance equation, $V_c + V_w + V_s + V_a = 3273.75cm^3$
$(x/3 + 0.5x + 2x/2.5 + 4x/2.6)m^3 = 3273.75cm^3 \times 10^3$

c From above equation we get
x = weight of cement = $1.0321Kg$
weight of sand = $2.0643Kg$
weight of coarse aggregates = $4.128Kg$
weight of water = $0.516Kg$