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 Modulus of Resilience $= 0.5 \times 1MPa \times 0.001 = 500Pa$.

b Offset method : draw line with slope E from $\epsilon = 0.2\%$ to cut stress-strain curve at yield point.
Equation of line 1 is $y = mx + c$, where
m = slope of elastoplastic part of curve = (1.2-1)MPa / (0.002-0.001) = 200MPa
$c = y - mx$ with $(x, y) \equiv (1, 0.001)$ so c $= 1MPa - 0.001 \times 200MPa = 0.8MPa$
Equation of line 2 is $y = mx + c$, where
m=slope of elastic part of curve = $(0 - 1)MPa/(0 - 0.001)$ =1GPa
$c = y - mx$ with $(x, y) \equiv (0, 0.002)$ so c $= 0 - 0.002 \times 1GPa = -2MPa$
From line 1 and 2, we get Yield stress, $\sigma_y = 1.5MPa$

c Toughness = Area under stress-strain curve till yield stress
Toughness $= 0.5 \times 1MPa \times 0.001 + 0.5 \times 0.5MPa \times 0.0025 + 1MPa \times 0.0025$ = 3.625kPa

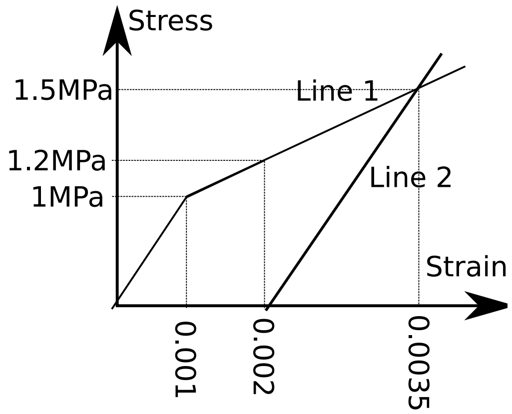

Figure 1: Stress-strain curve for Question 1

Q.2 **Solutions**

a Young's modulus of a material become zero in one case if it becomes perfectly plastic hence E=0, as given in Figure 2.

b Behavior of viscoelastic materials under constant strain is called relaxation. Creep is the term for constant stress behavior. It is shown in Figure 3.

c Basic models for viscoelastic representation are Hooke's spring and Newton's dashpot as shown in Figure 4. Composite models include Maxwell's, Kelvin's and Burger's etc as shown in Figure 5. *Any two model names and any one plot will be awarded full marks.*

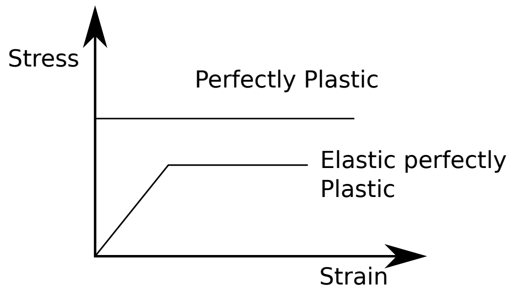

Figure 2: Stress-strain curve for Question 2(a)

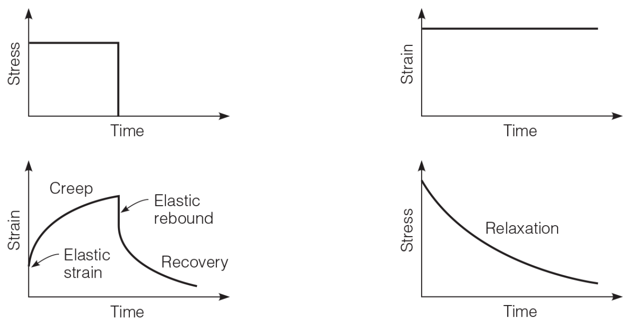

Figure 3: Stress-strain-time curve for Question 2(b)

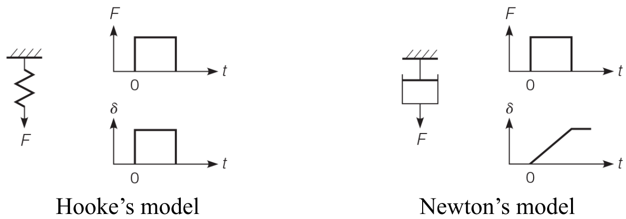

Figure 4: Stress-strain-time curve for Question 2(b)

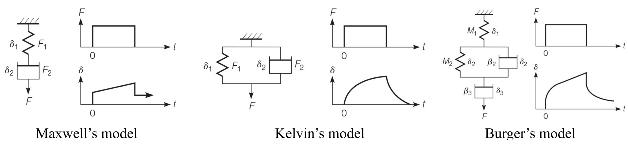

Figure 5: Stress-strain-time curve for Question 2(b)

Q.3 **Solutions**

a After gauging, hydration of cement mix starts and adding more dry cement will make the paste nonuniform and we get two paste with different initial setting time. Although it will not create much problem but best way to counter more water is to let the paste bleed.

b A chemical which causes same workability at lower water content is called plasticizers or water reducing agent.

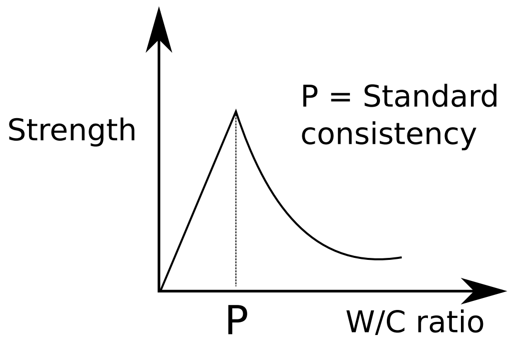

Figure 6: Strength v/s Water-cement ratio curve for Question 3(c)

c Given in Figure 6. Till standard consistency strength will increase and become maximum, after that it will decrease as more water will induce more void ratio.

Q.4 **Solutions**

a Three concretes A, B, C with proportions M20, M25, M30 are given. Assuming if straight is less, it contains 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. Increasing order of curing will be $M20 < M25 < M30$

b Size of aggregates $\propto$ Void ratio $\propto$ Workability. So increase in size of aggregate will increase workability and air content of concrete.

c $\mu = (80 + 60 + 90 + 75 + 100)/5 = 81$KN , Assuming population data,
$\sigma = \sqrt{[(80-81)^2 + (60-81)^2 + (90-81)^2 + (75-81)^2 + (100-81)^2]/n} = 15.16575KN$
Surface area of concrete block = $15 \times 15cm^2 = 225cm^2$
$f_{ck} = (\mu - 1.96\sigma)KN/225cm^2 = (81 - 1.96 \times 15.16575)/225 = 0.2252KN/cm^2$

Q.5 **Solutions**

a Volume of concrete= $0.25m^3$.
Air content of concrete mix = $(3 \times 0.25)/100 = 0.0075m^3$
Volume of concrete minus air in test cube = $0.25 - 0.0075 = 0.2425m^3$

b Let us assume weight of cement be x, for M20 (1:1.5:3)

	Cement	**Sand**	**Coarse aggregates**
Weight (Kg)	x	$1.5x$	$3x$
Density (gm/cc)	3	2.6	2.7
Volume ($m^3 \times 10^{-3}$)	$x/3$	$1.5x/2.6$	$3x/2.7$

Volume or Weight of water = $0.5x$ Volume balance equation, $V_c + V_w + V_s + V_a = 0.2425m^3$
$(x/3 + 0.5x + 1.5x/2.6 + 3x/2.7) \times 1/1000m^3 = 0.2425m^3$
From above equation x = weight of cement = 96.178Kg

c Weight of sand = $144.267Kg$
weight of coarse aggregates = $288.534Kg$
weight of water = $48.089Kg$