DETAILS EXPLANATIONS

CE : Paper-2 (Paper-4) [Full Syllabus]

[PART : A]

1.
- It should feel smooth when touched between fingers.
- If hand is inserted in a bag or heap of cement, it should feel cool.

2. Brick or stone masonary laid in mortar to be tested are crushed in compression machine. The load at which the masonary crushes gives the crushing strength.

3. Silica, in it's free form, it has a deterimental effect of the properties of lime.

4. It gives an indication of the quality of concrete with respect to consistancy cohesiveness and the proneness to segregation.

5. Coal-tar is cheap and effective preservative, also; it is fire resistant.

6. BOD_5 = 100 mg/lit
COD = 250 mg/lit
pH-value = 5.5 to 9.0

7. Maximum hourly discharge = 3 × Average dialy discharge
= 3 × 20 = 60 lit/sec

8. Kutter's formula :

$$C = \frac{23 + \frac{0.00155}{S} + \frac{1}{n}}{1 + \left(23 + \frac{0.00155}{S}\right)\frac{n}{\sqrt{R}}}$$

9. There is no specific relationship between friction factor and reynold's number for transition flow in pipes.

10. It can be applied in :
Open channels, notches and weirs, spill-ways, and Dams, liquid jets from orifice, ship partially submerged.

11. $$\frac{p}{w} = \frac{V}{\sqrt{\rho g^2\left(\frac{1}{K} + \frac{D}{tE}\right)}}$$

where, D = Dia of pipe
t = Thickness of piep
E = Elastic modulus

12. |FB – BB| = 180°
Back bearing = (N35°E) ±180°
B.B. = S35°W

13. Length of closing line :

$$= \sqrt{(\Sigma L)^2 + (\Sigma D)^2}$$

$$l = \sqrt{(0.4)^2 + (-0.3)^2} = 0.5 \text{ m}$$

14. Length of curve $= R.\Delta^C = R \times \frac{\Delta^\circ \times \pi}{180^\circ} = 200 \times \frac{60^\circ \times \pi}{180^\circ}$

$l = 209.43$ m

15. Silt pressure :

$$F_{silt} = \frac{1}{2} K_a \gamma_{sub} h_s^2$$

Where, h_s = Height of silt from base

γ_{sub} = Submerged unit-weight

16. Net irrigation requirement

NIR = $C_u - p_{eff}$ + Leaching – Requirement

= 40 – 20 + 10

NIR = 30 cm

17. Delta, $\Delta = \frac{2B}{D} = \frac{2 \times (2 \times 30)}{200} = 0.6$ feet

18. Sounding weight

$w = 50 \ \bar{v} \ y$

$w = 50 \times 2.5 \times 20$

$w = 2500$ N

Weight $w = \frac{2500}{9.81} = 254.84$ kg

19. ***Prism-storage :***

It is the volume formed by an imaginary plane parellel to the channel bottom drawn at the outflow section water-surface.

20. It is the plot of the discharge in a stream plotted against time chronologically.

[PART : B]

21. This is the cast treatment which given to the water and this is very important for the purpose of drinking water because in this process killing of the micro-organism it taking place, in this Cl_2 chlorine is added to water Cl_2 reacts with water pH > 5 and Cl_2 is added in such a amount that after 10 minutes contact period 0.2 mg/lit is ensured as residual.

22. ***Effect on Plants :***

- SO_2, Hydrogen fluoride, Ozone, Cl_2, HCl, NO_2 etc. affect plants. They are toxic for the plant.
- Recovery of plant from hydrogen, fluoride effect is much slower than SO_2 attack.
- Chlorine is more toxic to vegetation than SO_2 by a factor of two or three.

23. Let, diameter = D

Area of flow = $\left(\frac{\pi}{4}D^2\right)\times\frac{1}{2} = \frac{\pi}{8}D^2$

Wetted perimeter = $\frac{\pi D}{2}$

Hydraulic radius = $\frac{A}{P} = \frac{(\pi/8)D^2}{(\pi/2)D} = \frac{D}{4}$

Velocity $\Rightarrow V = \frac{1}{n}R^{2/3}.S^{1/2}$

$$\Rightarrow \quad 1.9 = \frac{1}{0.012}\times\left(\frac{D}{4}\right)^{2/3}\left(\frac{1}{400}\right)^{1/2}$$

$$\Rightarrow \quad D = 1.232 \text{ m}$$

24. ***Durability :*** A good building stone should be durable. The various factors contributing to durability of a stone are it's chemical composition, texture, resistance to atmospheric and other influences, location in structure etc.

So, the stone should be so arranged in a structure that the natural bed is perpendicular or nearly so to the direction of pressure.

25. ***Chemical Seasoning :*** This is also known as the salt seasoning. In this method, the timber is immersed in a suitable salt. It is then taken out and seasoned in the ordinary way. The interior surface of timber dries in advance of exterior one and chances of formation of external cracks are reduced.

26. ***Properties of Contour-lines :***

- Closely spaced contour lines represent steep slope.
- Uniformly spaced contours represent uniform slope.
- Two or more contours never cut each other.
- Two or more contours joining at a point represent vertical cliff.
- Contour lines always form a close loop.
- Closed loopes of contours having increasing elevation inwards show hill and increasing outwards show 'Depression'.

27. (i) T.B. = M.B. ± M.D.

$\Rightarrow$ 45° = M.B. + 5

$\Rightarrow$ M.B. = 40°

(ii) T.B. = M.B. ± M.D.

$\Rightarrow$ T.B. = $32^\circ30' - 2^\circ30'$

$\Rightarrow$ T.B. = 30°

(iii) T.B. = N45°W = $(360^\circ - 45^\circ) = 315^\circ$

M.B. = N50°W = $360^\circ - 50^\circ = 310^\circ$

T.B. = M.B. + M.D.

$315^\circ = 310^\circ$ + M.D.

M.D. = 5°E

28. ***Local-Attraction :***

The compass contains magnetic needle, which aligns aligns along the magnetic lines of force due to earth's magnetism and points N-S direction. However, the magnetic needle will not point to the magnetic north, when it is under the influence of the external attractive forces. The magnetic material deflects the magnetic-needle so that magnetic needle doesn't give correct readings, this defect is called local attraction.

29. b = 3m ; d = 2 m

$$h = \frac{2}{2}+3 = 4 \text{ m}$$

Water leavel from centre of orifice applying bernoulli's equation

$$\frac{p_1}{\rho g}+\frac{v_1^2}{2g}+z_1 = \frac{p_2}{\rho g}+\frac{v_2^2}{2g}+z_2$$

$$v_2 = \sqrt{2gz}$$

$\because$ $p_1 = p_2 = p_{atm}$

$z_1 - z_2 = 4$ m

$v_1 = 0$

$$v_2 = \sqrt{2\times9.81\times4} = 8.86 \text{ m/s}$$

Discharge = C_dQ_{th}

= 0.62 × Area × Velocity

= 0.62 × (3 × 2) × 8.86

Q = 32.95 m^3/sec

30. Shear stress ; $\tau = \frac{\mu v}{y}$

μ = 2.5 kg/m.s, V = 1.75 m/s, y = 5 mm = 5×10^{-3} m

$$\tau = \frac{2.5 \times 1.75}{5 \times 10^{-3}} = 875 \text{ N/m}^2$$

31. ***Vehicles :*** The vehicles are the liquid substonces which hold the ingredients of a point in liquid suspension. They are required mainly for two reasons.

(i) To make its possible to spray the paint evenly and uniformly on the surface in the form of a thin layer; and

(ii) To provide a binder for the indredient so a paint so that they may stick or adhere to the surface.

32. The term 'macadam' in the present day means, the ravement base course made of crurhed or broken aggregate mechanically interlocks by rolling and the vaids filled with screening and binding material with the assistance of water. The WBM may be used as a sub base. Base course or even surfacing course of low volume roads. The thickness of each compacted layer of WBM layer depends on the size and gradation of the aggreagates used.

[PART : C]

33. The defects occuring in the timber are grouped into the following divisions :

Defects due to Conversion :

During the process of converting timber into commerical form. The following defects may occur.

- ***Chip mark :*** The defect is indicated by marks or signs blaced by chips on the finished surface of timber.
- ***Diagonal Grain :*** This defect is formed due to improper sauring of timber.
- ***Torn Grain :*** This defect is callsed when a small depression is formed on the fimished surface of timber by falling of a torl or so.
- ***Wane :*** This defect is denoted by the presince of original rourded surface on the manufuctured piece of timber.

Defects due to Fungi :

The fungi are minute microscapic plant organisms. They attack timber only when inaisture content of timber is above 20% and there is bresence of air and wearinth for the growth of fungi.

Blue stain brown rate, heart rate, sap stain, we rat and white rat, some of them are described below :

- ***Blue Stain :*** The sab of wood is stained to bluish colour by action of certain kind of fungi.
- ***Dry Rat :*** The fungi of certain types feed on wood and during feeding, they attack on wood and convert it into dry powder form. This is known as the dry rate.
- ***Brown Rat :*** The fungi of certain types, remove celludose compounds from wood and hence the wood assumes the brown colour. Thir is knows as brown rot.
- ***Wet Rat :*** Some verieties of fungi causing chemical decompsition of wood of the timber and in doing so, they convert timber into a greyish brown powder.

Defects due to Natural Forces :

The main natural forces responsible for causing defects in timber are two, mamely abonormal growth and rupture of tissues. Burls, knats, shakes, druxiness, foxiness, etc. are some of the defects due to natural forces.

- ***Knots :*** There are the base of branches or limbs which are broken or cut off from the tree.
- ***Callus :*** It indicates soft tissue or skin which convers the wound of a tree.
- ***Burls :*** These are also known as the excrescences and they are barticularly formed when a trese has received shock or injury in its young age.
- ***Druxiness :*** This defect is indicated by white decayed spots which are cancelled by healthy wood.

Defects due to Seasoning :

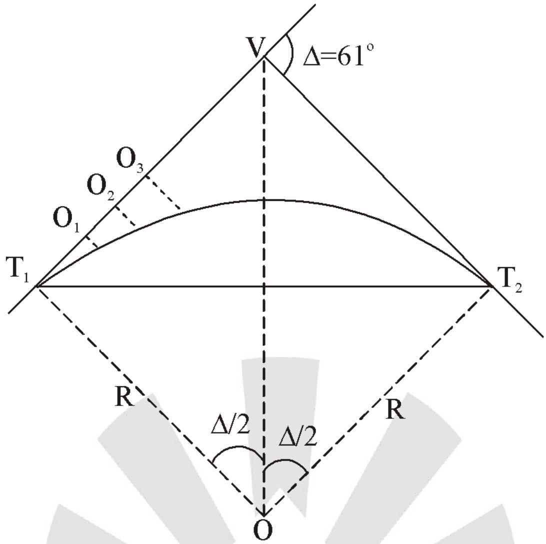
Bow, case hardening, check, collabse, cup, noney combing radial shakes, sblit, taist, wrap etc. are the defects due to reasoning.

- ***Bow :*** It is a curvature of the timber in the direction of its length.
- ***Cup :*** A curvature in the transverse durection of the timber.
- ***Twist :*** It is a spirial distortion along the length of the timber.
- ***Sbring :*** It is a curvature of the timber in its own plane.

34. Dams can be broadly classified as ancient types of dams and modern type of dams. Ancient type of dame are earthen dams, rock fill dams and solid masonary gravity dams. Modern types of dams are hollow masonary gravity dams, timber dams, steel dams and arch dams. Some general information on all these dams is as follow :

- ***Earthen Dams :***
  These are made of soil that is pounded down solidly. They are built in areas where the foundation is not strong enough to bear the wiehgt of a concrete dam and where earth is more easily vailable as a bulding material compared to concrete, stone or rock, example is Hirakud Dam in India.
- ***Solid Masonary Gravity Dam :***
  These are built with solid blocks of concrete which hold back the flow of water by shear weight. They can be constructed on and dam site, shere there is a natural foundation storng enough to bear the great weight of the dam. Example is Bhakra Nagal Dam in India.
- ***Fockfill Dams :*** Rockfill are formed of loose rocks and boulders piled in the river bed. A slab of RCC is often laid across the upstream face of a rockfill dam to make it water tight. *Example* is Tehri Dam in India.
- ***Hollow Masonry Gravity Dam :***
  There are essentially designed on the smae principle on which solid masonary graivty dams are designed, but they contain less concrete or masonary; about 35 to 40% or so, generally the wight of water is carried by a deck of RCC or by arches that share the weight burden they are difficult to bult and are adapted only it very skilled labour is earily available, atherwise the labour cost is too high to build its complex structure.
- ***Steel Dams :***
  These are used as temporary coffer dam needed for the construction of permanent dams. These are ussually reinforced with timber or earthfill.
- ***Timber Dams :*** These are short lived since in a few years time, rotting sets in their, life is not more than 30 to 40 years and must have regular maintenance during that time.
- ***Arch Dams :***
  These are very complex and comblicated. They make use of horizontal arch section in place of weight to hold back the water.

35. Let, T_1 and T_2 be the two tangent points on the circular curve. v be the intersection baing of tangents and Δ to be deflection angle. R be the radius of curve.



$$R = 20 \text{ chains} = 20 \times 20 = 400 \text{ m}$$

Tangent lengths,

$$VT_1 = VT_2 = R \tan\frac{\Delta}{2} = 400 \tan\left(\frac{61^\circ}{2}\right) = 235.62\text{m}$$

$$\text{Length of curve, } L = \frac{\pi R \Delta}{180^\circ} = \frac{\pi \times 400 \times 61^\circ}{180^\circ} = 425.86 \text{ m}$$

Chainage of baint of inter section,

$$V = 50 \times 20 + \frac{60}{100} \times 20 = 1012 \text{ m}$$

Chainage of paint T_1 = Chainge of V-VT_1

$$= 1012 - 235.62 = 776.38 \text{ m}$$

Chainage of paint T_2 = Chainage of T_1 + length of curve

$$= 776.38 + 425.86 = 1202.24 \text{ m}$$

Length of chord $T_1T_2 = 2R \sin\frac{\Delta}{2}$

$$= 2 \times 400 \times \sin\left(\frac{60^\circ}{2}\right) = 406.03 \text{ m}$$

Chainage of the first full station = 780.00 m

Length of first subchords C' = 780.00 – 776.38 = 362 m

Length of moral chord C = 20 m

Length of last subchord C" = 1202.24 – 1200 = 2.24 m

Number of full chords = $\frac{1200-780}{20}$ = 21

Total number of chords = 1 + 21 + 1 = 23

Length of first offset

$$O_1 = \frac{(C')^2}{2R} = \frac{(3.62)^2}{2\times400} = 0.016 \text{ m}$$

Length of the second offset,

$$O_2 = \frac{C}{2R}(C+C) = \frac{20}{2\times400}\times(20+3.62) = 0.59 \text{ m}$$

Length of all immediate offsets

$$O_3, O_4, O_5 \ldots Q_{22} = \frac{C^2}{R} = \frac{(20)^2}{400} = 1 \text{ m}$$

Length of last offset,

$$O_{23} = \frac{C''}{2R}(C+C'') = \frac{2.24}{2\times400}(20+2.24) = 0.062 \text{ m}$$

36. Basin tag, $t_p = C_t(L.L_c)0.3$

Here C_t = 1.85 ; L = 80 km ; L_c = 50 km

$\therefore$ $t_p = 1.85 \times (80 \times 50)^{0.3}$

$\Rightarrow$ t_p = 22.72 hrs.

Now, a standard duration of effective rainfall in hrs is given by

$$t_r = \frac{t_p}{5.5} \Rightarrow t_r = \frac{22.27}{5.5} = 4.05 \text{ hrs}$$

When a non-standard rainfall duration t_r hours is adopted, instead of the standard value, t_r to derive a unit hydrograph the value of basin lag is affected.

The modified basin lag is given by

$$t_{p'} = \frac{21}{22}t_p + \frac{t_R}{4}$$

Here t_R = 3 hrs

$$\therefore \quad t_{p'} = \frac{21}{22}\times22.27+\frac{3}{4} = 22.01 \text{ hrs.}$$

Therefore, the peak discharge for a non standard ER of duration t_R in m³/s is igiven by

$$Q_p = \frac{2.78 C_p A}{t_{p'}}$$

where, $C_p = 0.45$; $A = 2100$ km² ; $t_{p'} = 22.01$ hrs

$$\Rightarrow \quad Q_p = \frac{2.78 \times 0.48 \times 2100}{22.01} \Rightarrow Q_p = 119.37 \text{ m}^3\text{/sec}$$

Now the peak discharge per unit catchment area in m³/s/km² is given by

$$q = \frac{Q_p}{A} = \frac{119.37}{2100} = 0.0568 \text{ m}^3\text{/s/km}^2$$

∴ The width (in time units) are given as

$$w_{50} = \frac{5.87}{9^{1.08}} = \frac{5.87}{(0.0568)^{1.08}} = 129.89 \text{ hrs}$$

and $$w_{75} = \frac{w_{50}}{1.75} = \frac{129.89}{1.75} = 79.22 \text{ hrs}$$

Where, w_{50} = Width of unit hydrograph in hrs at 50% peak discharge.

w_{75} = width of unit hydrograph in hes at 75% peak discharge.

Also base,

$$t_b = 72 + 3t_{p'}$$
$$= 72 + 3 \times 22.01 = 138.03 \text{ hrs}$$

37. Let volume of cement be V_c m³, volume of sand be V_s m³, volume of aggregate be V_a m³, weight of cement be w_c kN, weight of sand be w_s kN, weight of sand be w_s kN, weight of aggregate be w_a kN, weight of water be w_w kN.

Given, $V_c : V_s : V_a = 1 : 1.4 : 2.8$

$$\frac{V_c}{V_s} = \frac{1}{1.4} \Rightarrow V_s = 1.4\, V_c$$

$$\Rightarrow \quad \frac{V_c}{V_a} = \frac{1}{2.8} \Rightarrow V_a = 2.8\, V_c$$

$$\frac{w_w}{w_c} = 0.48 \text{ and entrained air} = 2\%$$

Now we know that,

Net volume of concrete = Total volume – Entrained air volume

$\Rightarrow$ Net volume of concrete = $1-\left(\frac{2}{100}\times 1\right)$ = 0.98 m^3

But net volume of concrete = Volume of water + Volume of Solids

$$0.98 = \frac{\text{Weight of water}}{\text{Density of water}} + \frac{\text{Weight of Solids}}{\text{Density of Solids}}$$

$$0.98 = \frac{0.48W_c}{9.81} + \left[\frac{w_c}{G_c \times 9.81} + \frac{w_s}{G_s \times 9.81} + \frac{w_a}{G_a \times 9.81}\right]$$

$$0.98\times 9.81 = 0.48\ w_c + \frac{w_c}{G_c} + \frac{w_s}{G_s} + \frac{w_a}{G_a}$$

$$0.98\times 9.81 = \left[0.48\times 14.7V_c + \frac{14.7V_c}{3.15} + \frac{16.66\times 1.4V_c}{2.6} + \frac{15.68\times 2.8V_c}{2.5}\right]$$

V_c = 0.254 m^3

V_s = 1.4V_c = 0.356 m^3

V_a = 2.8 V_c = 0.712 m^3

So, Weight of cement in kg = $\frac{0.254\times 14.7\times 10^3}{9.81}$ = 381.21 kg

Weight of sand in kg = $\frac{0.356\times 16.66\times 10^3}{9.81}$ = 604.85 kg

Weight of coarse aggregate in kg

$= \frac{0.712\times 15.68\times 10^3}{9.81}$ = 1138.55 kg

38. Assuming that the town is provided with a planned water supply at average rate of 150 LPCD and 80% of this water supply is converted into sewerage.

$\because$ Quantity of sewage produced per day

$= \frac{80}{100}\times 150\times 50000$ = 6000000 lit = 6000 m^3

Quantity of sewage produced by second :

$= \frac{6000}{24\times 60\times 60}$ = 0.0694 m^3/sec

$\therefore$ Average sewage discharge = 0.0694 m^3/sec

Maximum sewage discharge = 3 × Average sewage discharge

= 3 × 0.0694 = 0.2083 m^3/sec

The storm-water discharge = kpA

k = 0.65 ; T = 20 minutes ; A = 90 ha = 90 × 10^4 m^2

p = Design rainfall intensity (cm/hr)

The value of 'p' may be calculated as

$$p = \frac{100}{T+20}$$

where, T = Time of concentration in minutes

$$\Rightarrow \quad p = \frac{100}{20+20} = 2.5 \text{ cm/hr}$$

$\therefore$ Storm water discharge

$$= 0.65 \times \frac{2.5\times10^{-2}}{60\times60}\times90\times10^{4} = 4.0625 \text{ m}^3\text{/sec}$$

Hence, the peak discharge for which the sewars of the proposed combined system should be designed

$\Rightarrow$ Maximum sewage discharge + Maximum storm discharge

$$= 0.2083 + 4.0625 = 4.2708 \text{ m}^3\text{/sec}$$

39. The commonly used portland cement in india is branded as 33 greade (IS : 269 - 1989), 43-grade (IS : 8112 - 1989) and 53 grade (IS : 12269 - 1987) having 28 days mean compressive strengths exceeding 33 MPa, 43 MPa and 53 MPa respectively. All the three grades are produced from same materilas. The higher strengths are achieved by increasing C_3S content and also by finely grinding the clinker. The fineness of 53 grade OPC obtained by blain's air permeabiltiy test is specified to be of the order of 350000 mm^2/gm. The initial and final setting times are same for all the three grades. The 33 grade cement has virtually disappeared and had been displaced by high strength 43 grade cement. The minimum compressive strength of the 43 grade cement are 23 MPa and 33 MPa at the end of 3 and 7 days respectively. At higher water riatios, the concrete produced with high strength cement has about 80% higher strength and at lower water cement ratio, it has 40% higher strength than that of concrete using 33 grade cement. Greater fineness of 43 and 53 grade cement increase workability due to reduction of friction between aggregates. Moreover, due to shorter setting time and faster development of strength the stripping time is shorter. Although, cements of grade 43 and 53 are desirable for economical design of high grade concretes but they can also be used for lower grade concretes.

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