DETAILS EXPLANATIONS

CE : Paper-2 (Paper-5) [Full Syllabus]

[PART : A]

1. It is obtained by using Le chatelier's flask.

2.
- Bulk density
- Kind of binding materials
- Nature of application
- Special mortars

3. Finer the materials more will be the increase in volume for a given moisture content.

4. The term corrosion is used to indicate the conversion of metals by natural agencies into various compounds.

5. $$s_{t_c} = \frac{E\alpha T}{3(1-\mu)}\sqrt{\frac{a}{l}}$$

6. Rigid pavement are those which passes not worthy flexural strength and stresses are not transfered from grain to grain to the lower layers.

7.

Penetration	Standard load
2.5 mm	1370 kg
5 mm	2055 kg

8. To classify the fine grained soils within one group and for judging their suitability as subgrade material, an indexing system is introdused, which is termed as group index of soils.

9. Crop factor (k) is determined for each other crop, its value depends upon certain environmental conditions.

10. Readily available moisture for the plant

$$= F_e - M_o$$
$$= 20 - 11 = 9 \text{ cm}$$

11. Evaporation is a cooling process in which the latent neat of evaporation of about 580 cal/gm is provided by the water body.

12. A sounding rod is a pole of a sound straight grained well seasoned tough timber usually 5 to 8 cm indiameter and 5 to 8 meters long.

13. It is that type of surveying in which the shape of the earth is taken into account.

14. Contour interval (m) $= \frac{25}{\text{Number of cm per km}}$

$$\text{C.I.} = \frac{25}{10} = 2.5 \text{ m}$$

15. $\frac{\partial p}{\partial t}+\frac{\partial}{\partial x}(pu)+\frac{\partial}{\partial y}(pv)+\frac{\partial}{\partial z}(pw) = 0$

16. It is defined as the distance from the boundary surface in which the velocity reaches the 99% of the velocity of the main stream.

17. the length of pipe from its entrance upto the point where flow attains fully developed velocity profile and which remains unaltered beyond that know as entrance length.

18. Critical depth for triangular channel

$$y_c = \left[\frac{2Q^2}{g\tan^2\theta}\right]^{1/5}$$

19. It is ratio of D_{50} of gravel to D_{50} of aquifer.

20.
- Depth of sand = 90 – 110 cm
- Rate of filteration = 2400 – 4800 lit/m^2/day

[PART : B]

21. *Use of Camber :*

Camber is the lateral/transvers slope on road etc. It is provided for the drainage of rainfall water. Sometimes it also acts as superelevation.

Surface Type	Low Rainfall	Heavy Rainfall
Bituminous	2.5%	2.0%
Cement Concrete	1.7%	2.0%
WBM/Gravel	2.5%	3.0%
Earth	3.0%	4.0%

22. Magnetic declination is the horizontal angle between magnetic north and true North. SO it is the difference between true and magnetic bearings of any line.
- It is positive (+ve) for eastward declination.
- It is negative (–ve) for westward declination.

23.
- English bond is much stronger than flemish bond for the walls thicker more than $1\frac{1}{2}$ bricks.
- Flemish bond shows more attractive and pleasing appearance of masonary works.
- Flemish bond is economical as it uses brocken brick bats; although it requires some extra mortar.
- Uses of flemish bond is a bit difficult than english bond. Flemish bond requires more skilled labour and supervision.

24. ***Most Economical Section*** : It is the cross section of open channel which has the maximum discharge for given cross sectional are of section which requires minimum cross sectional area for the given discharge. for triangular most economical section that the vertex angle should be 90°.

25. ***Conflict Points*** :These are the imaginary points on which the traffic lines intersect. i.e., these are the points on which vehicles have probability to get accident.

For fourway intersection, possible number of conflict points are 32.

26. A trickling filter, also called tricking bio-filter, bio filter, biological filter and biological trickling filter is a fixed bed, biological reactor that operates under (mostly) aerobic conditions. Pre settled is continuously 'trickled' or 'sprayed' over the filter as the water migrates through the pores of the filter, or organics are aerobicallly degraded by the biofilm covering filter material.

27. Population increase in 40 years

$$= 47000 - 25000 = 22000$$

So, population increase per year $= \frac{22000}{40} = 550$

So, population in year 2000 $\Rightarrow 47000 + (550 \times 30) = 63500$

and in year 2006 $= 63500 + (550 \times 6) = 66800$

28. Stopping sight distance (s) :

$$s = (0.278\ V.t_R) + \frac{V^2}{254(f)}$$

$$s = (0.278 \times 70 \times 2.5) + \frac{70^2}{254 \times 0.35}$$

$$s = 103.76 \text{ m}$$

29.

$$l_1 = 1200 \text{ m} ; D_1 = 750 \text{ mm}$$

$$l_2 = 750 \text{ m} ; D_2 = 600 \text{ mm}$$

$$l_3 = 600 \text{ m} ; D_3 = 400 \text{ mm}$$

For series connection :

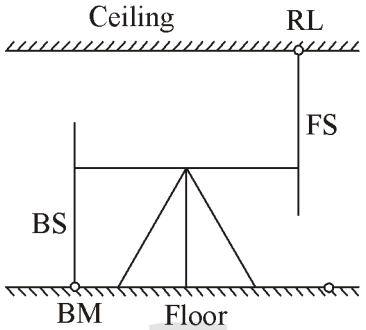
To calculate equivalent diameter of pipe :

$$\frac{L}{D^5} = \frac{L_1}{D_1^5} + \frac{L_2}{D_2^5} + \frac{L_3}{D_3^5}$$

$$\frac{2280}{D^5} = \frac{1200}{750^5} + \frac{750}{600^5} + \frac{600}{400^5}$$

$$D = 545.46 \text{ mm}$$

30. As per the given conditions



$$RL = BM + BS + FS$$
$$RL = 230.625 + 2 + 2.215$$
$$= 234.840 \text{ m}$$

31. ***Environmental Impact Assessment :***

Assessing the nature and extent of degradation of environment due to human interferance is called envionmental impact assessment. Engineering project involving development of thermal power, mining-operations and even river valley projects have been found to be causing certain adverse and negative impacts on our surrounding environment, which has forced us to make it compulsory to evaluate these adverse impacts in detail, well before the project is cleared for execution.

32. Sewage treatment is the process of removing contaminant from municipal waste water, containing mainly household sewage plus some industrial waste water physical, chemical and biological processes are used to remove contaminant and produce treated waste water that is safe-enough for release into environment.

A by product of sewage treatment is a semi solid waste or slurry, called sewage sludge. The sludge has to undergo further treatment before being suitable for disposal or application to land.

[PART : C]

33. Composting of refuge is a biological method of discomposing solid wastes. This decomposition can be effected either under aerobic or anerobic conditions or both. The final end product is a manure called compost or humus, which is in great demand in european countries as fertilizer for farms basically compositing is considered to be anerobic process, because it involves piling up of refuge and it's regular turing either manually or by mechanical devices.

So as to ensure sufficient supply of air and oxygen during it's decomposition by bacteria, fungii and other micro-organisms like antinomycetes. Initially the process starts with mesophilic bacteria, which oxidise the organic matter to carbon-di-oxide and liberate heat. The temperature rises to about 45°C and at the point, the thermophilic bacteria take over and continue the de-composition. During this phase temperature further rises to about 60°C. After three weeks, the compost is stabilized and this is shown by appreciable fall in the temperature of the compost mass. the final compost should have an earthy small and a dark brown colour.

Moisture content of the compost mass should be controlled because excessive moisture will make it difficult to maintain aerobic conditions while deficient moisture inhibits biological life. It may sometimes, becomes necessary to add water to the compost mass during it's turning, for maintaining satisfactory moisture content Two methods which are generally adopted in composting are indoor method which is an aerobic method and Banglore method which is an anerobic method.

34. A cross drainage work is a structure which is constructed at the crossing of a canal and a natural drain, so as to dispose of drainage water without interrupting the continous canal supplies. In whatever way the canal is aligned. Such cross drainage works generally becomes unavoidable. A cross drainage work is generally a costly construction and must be avoided as far as possible since a watershed canal crosses minimum number of drains such an alignment is preferred to a contour canal which crosses maximum number of drains.

Types of cross drainage works are as follows :

- ***Aqueduct and Syphon Aqueduct :***

  In these works, the canal is taken over the natural drain, such that the drainage water runs below the canal either freely or under syphoning pressure.

  When the HFL of the drain is sufficiently below the bottom of the cannal, so that the drainage water flows freely under gravity, the structure is known as an aqueduat.

  The HFL of the drain is higher than the canal bed and the water passes through the aqueduat barrels under syphonic action, the structure is known as syphon aqueduct.

- ***Super Passes and Syphon :***

  In these works, the drain is taken over the canal such that the canal water runs below the drain either freely or under syphoning pressure. When FSL of the canal is sufficiently below the bottom of the drain trough, so that the canal water flows freely under gravity, the structure is known as a super passage.

If the FSL of the canal is sufficiently above the bed level of the drainage through. So that the canal flows under syphonic action under the through, the structure is known as a canal syphon or a syphon.

- ***Level Crossing :***

In this type of cross drainage work, the canal water and drain water are allowed to intermingle with each other.

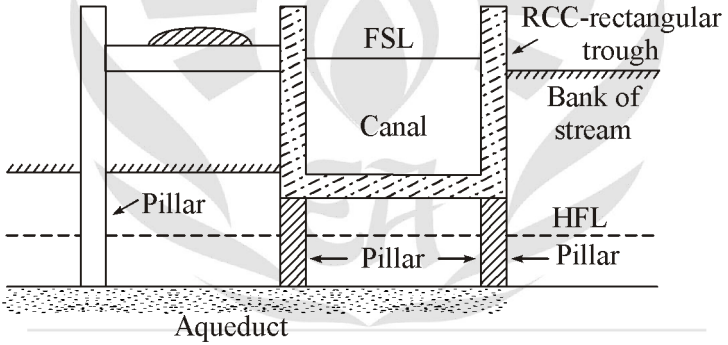
A level crossing is provided generally when a large canal and a high drainage approach each other practically at the same level.

- ***Inlets and Outlets :***

An inlet is a structure constructed in order to allow the drainage water to enter the canal and get mixed with the canal water and thus to help in augmenting canal supplies.

Such a structure is generally adopted when the drainage discharge is small and the drain. Crosses the canal with its bed level equal to or slightly higher than the canal FSL.

When the drainage discharge is figh or if the canal is small, so that the canal cannot take the entire drainage water, an outlet may sometimes be constructed to escape out the additional discharge at a suitable site a little down stream along the canal.



35. *The various test which are performed on clay bricks are :*

- ***Water Absorption Test :***

The clay bricks are tested in accordance with the procedure laid down in IS : 3492 : 1992. The code recommends that this test should be performed in both cold water and boilling water. This is because water absorption in bricks occur in the pores and many times pores are completely sealed and hence inaccessible to water under ordinary conditions. As per the code the average water absorption of common building bricks should not be more than 20% by weight upto class 12.5 MPa and 15% by weight for higher classes.

- ***Crushing Strength Test :***

  Bricks often have to withstand great compressive stresses. The durability of the masonary depends upon the strengths of the bricks. The crushing or compressive strength of a brick is found out by placing it in a compression testing machine. As per IS : 1077 - 1992, the minimum crushing strength of bricks is 3.5 MPa.

- ***Hardness Test :***

  In this test a scratch is made on brick surface with the help of a finger nail. If no impression is left on surface, the bricks is treated to be sufficiently hard.

- ***Soundness Test :***

  In this test the two bricks are taken and they are structure with each other the bricks should not break and a clear ringing should be produced. As a result the shape of the bricks will be lost. However, a small quantity of lime not exceeding 5% is desirable in good bricks.

- ***Presence of Soluble Solts Test :***

  The soluble solts, present in bricks will cause efflorescene on the surface of bricks for finding out the presence of soluble salts in a bricks it is immersed in water for 24 hours. It is then taken out and allowed to dry in shade. The liability of efflorescence is reported as 'nil', 'slight,' 'moderate', heavy and serious according to the limits specified by IS : 3495 - 1992.

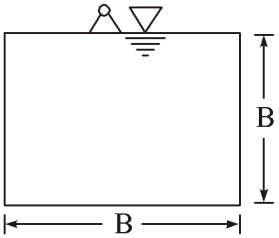
  - ***Nil :*** When there is no perceptible deposit of efflorescence.
  - ***Slight :*** When no more than 10% of the area of the brick is covered with a thin deposit of salts.
  - ***Moderate :*** When deposition is more than 10% and covering upto 50% of the exposed area of the brick surface but unaccompained by powdering or flaking of the surface.
  - ***Heavy :*** When there is a heavy deposit of salts covering 50% or more of the exposed area of the brick surface but unaccompained by powdering of flaking of the surface.
  - ***Serious :*** When there is a heavy deposit of salts accompained by powdering and of flaking of the expased surfaces.

36. Let width of rectangular channel = B

$\therefore$ Depth of flow = B

$\therefore$ Area $A_1 = B^2$

Wetted perimeter $P_1 = B + 2B = 3B$



Hydraulic radius $R_1 = \frac{A_1}{P_1}$

$$= \frac{B^2}{3B} = \frac{B}{3}$$

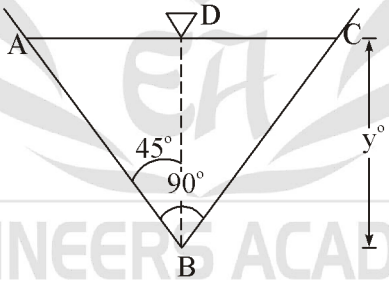
$\therefore$ Discharge in the rectangular channel

$$Q_1 = A_1 \frac{1}{n}(R_1)^{2/3} S^{1/2}$$

$$\Rightarrow \quad Q_1 = B^2 . \frac{1}{n}\left(\frac{B}{3}\right)^{2/3} S^{1/2}$$

$$\Rightarrow \quad Q_1 = \frac{1}{n} B^2 \left(\frac{B}{3}\right)^{2/3} S^{1/2}$$

Now, for a triangular channel of apex angle 90°, we have



Let, Depth of flow = y_0°

Now $\cos 45^\circ = \frac{BD}{AB}$

$$\Rightarrow \quad AB = \frac{BD}{\cos 45^\circ} = \frac{y_0}{\cos 45^\circ}$$

Also, $\tan 45^\circ = \frac{AD}{BD}$

$$\Rightarrow \quad AD = BD \times \tan 45^\circ = y_0 \times \tan 45^\circ$$

$\therefore$ Area $A_2 = \frac{1}{2} \times BD \times AC$

$= \frac{1}{2} \times y_0 \times 2 \times y_0 \times \tan 45^\circ = y_0^2$

Wetted perimeter $P_2 = AB + BC = 2\ AB$

$$P_2 = 2 \times \frac{y_0}{\cos 45^\circ} = 2\sqrt{2}\, y_0$$

$$R_2 = \frac{A_2}{P_2} = \frac{y_0^2}{2\sqrt{2}\, y_0} = \frac{y_0}{2\sqrt{2}}$$

Now, flow areas in both channel as same

$$A_1 = A_2$$

$$B^2 = y_0^2$$

$$B = y_0$$

Now, $Q_2 = A_2 . \frac{1}{n} (R_2)^{2/3} . S^{1/2}$

$$Q_2 = y_0^2 \frac{1}{n} \left(\frac{y_0}{2\sqrt{2}} \right)^{2/3} S^{1/2}$$

Ratio of discharge $= \frac{Q_1}{Q_2}$

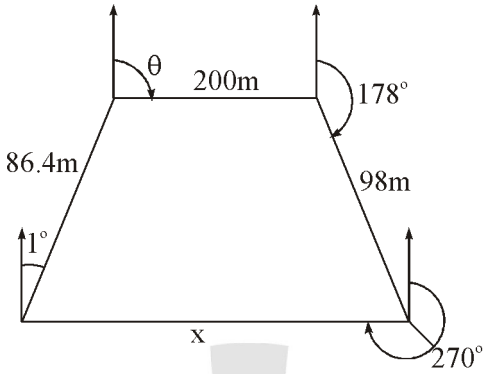
$$\frac{Q_1}{Q_2} = \frac{B^2 \frac{1}{n} \left(\frac{B}{3} \right)^{2/3} S^{1/2}}{y_0^2 \frac{1}{n} \left(\frac{y_0}{2\sqrt{2}} \right)^{2/3} S^{1/2}}$$

$$B = y_0$$

$$\frac{Q_1}{Q_2} = \frac{(B/3)^{2/3}}{(B/2\sqrt{2})^{2/3}}$$

$$= \left(\frac{2\sqrt{2}}{3} \right)^{2/3} = 0.961$$

37. Let the length of line CD be 'x' and the bearing of line AB be 'Q'. The closed traverse can be shown as below :



The lattitude and departure of each line can be calculated and tabulated as below :

Line	Length(m)	Bearing	Latitude	Departure
AB	200 m	θ	200 cosθ	200 sin θ
BC	98 m	178°	–97.94	3.42
CD	x	270°	x cos270°	x sin270°
DA	86.4 m	1°	86.39	1.51

We know that for a closed traverse :

(i) $\Sigma L = 0$

(ii) $\Sigma D = 0$

$$\Rightarrow \quad 200\cos\theta - 197.94 + x\cos 270^\circ + 86.39 = 0$$

$$\Rightarrow \quad 200\cos\theta = 11.55$$

$$\cos\theta = \frac{11.55}{200}$$

$$\Rightarrow \quad \theta = 86^\circ 41'21''$$

Also,

$$\Rightarrow 200\sin\theta + 3.42 + x\sin 270^\circ + 1.51 = 0$$

$$\Rightarrow 200\sin 86^\circ 41'21'' + 3.42 + (-1)x + 1.51 = 0$$

$$x = 204.596 \text{ m}$$

Thus the length of line CD is 204.596 m and bearing of AB is $86^\circ 41'21''$

38. The bituminous macadam (BM) is a premix laid immediately after mixing and then compacted. It is open graded construction suitable only as a base or binder course. When this layer is exposed as a surface course, at least a seal coat is necessary.

- ***Specifications of Materials :***

  The grades of bitumen used are 30/40, 60/70 and 80/100 penetration. Road tar (RT-4), cutback and emulsion can also be used in cold mix construction technique. The binder content used various from 3.4 to 4.5 percent by weight of the aggregates used are of low porosity fulfilling the following requirements for the base course.

  - Los-Angeles abrasion value 50% maximum
  - Aggregate impact-value 35% maximum
  - Flackiness Index 15% maximum
  - Stripping at 40°C after 24 hours immersion (CRRI test) 25% maximum
  - Loss with sodium sulphate, five cycles 12% maximum

  For binder course, the specified maximum abration and impact values are 40 and 30% respectively. The quantity of aggregates required for 10 m^2 of bitumen bound macadam are 0.60 to 0.75 m^3 and 0.90 to 1.00 m^3 respectively, for 50 and 75 mm compacted thickness, the bitumen quantity would be determined based on the gradings adopted.

- ***Plants and Equipment :***

  Various plants and equipment required for the job include sprayer, mechanical mixer or improvised hand mixer, spreader (mechanical paver or finisher, grader, or manual methods) and roller.

- ***Construction Steps :***

  (i) Preparation of Existing Layer : The existing layer is prepared to a proper profile.

  (ii) Tack coat or prime coat appreciation : A tack-coat is applied of thin layer of bitumen binder on the existing layer either using the sprayer or a pouring can.

  (iii) Premix : Preparation.

  (iv) Placement : The bituminous paving mixture is then immidiately placed on, the desired location and is spread with rakes to a predetermined thickness.

  (v) Rolling and Finishing : The rolling is done with 8 - 10 tonnes tandem roller. The finished surface should not show separate lines of markings due to defective or improper rolling.

39. 100% compaction is required for contributing the maximum strength. To enable the concrete to be fully compacted with given efforts, normally a higher water cement ratio than that calculated by theoritical considerations may be required. This is the say the function of water is also to lubricate the concrete so that the concrete can be compacted with specified effort forthcoming at the site of work. The lubrication required for handling concrete without segregation, for placing without loss of homogeneity, for compacting with the amount of efforts forthcoming and to finish it sufficiently easily, the presence of certain quantity of water is of vital importance. The quality of concrete satisfying above requirements is termed as workable concrete. It is very difficult to define precisely all the aspects of workability in a single definition. IS6461(Part VII) : 1973 defines workability as that property of freshly mixed concrete or mortar which determines the ease and homogeneity with which it can be mixed, placed, compacted and finished. The optimum workability of fresh concrete varies from situation to situation eg. the concrete which can be termed as workable for pouring into large sections with minimum reinforcement may not be equally workable for pouring into heavily r/f section. The following tests are commonly employed to measure workability:

- Slump Test
- Compacting factor test
- Flow test
- Kelly ball test
- Vee-Bee consistometer test

The In-situ determination of workability can be carried out by slump test. A concrete with slump value between 25 and 75 mm can be used in mass concreting foundations without vibration or lightly reinforced sections with vibration.

For a slump value of 50 - 100 mm concrete can be used in normal reinforced sections manually compacted and heavily reinforced secfinos with vibrations. For a slump value of 100 - 150 mm, concrete can be used for sections with congested reinforcement. It can be used for pumping and tremie placing.

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