Test ID:- C22

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SOLUTIONS

CIVIL ENGINEERING : PAPER-2

Full Length Test -16

Exam Date :- **01 March 2026**

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2 Marks

Q.1

Sol.

For $K = 3.0$

$$l = \left[\frac{Eh^3}{12K(1-\mu^2)}\right]^{1/4} = \left[\frac{210000 \times 15^3}{12 \times 3(1-0.15^2)}\right]^{1/4} = 67.0\,\text{cm}$$

Q.2

Sol. Hydraulic diameter is a parameter used to characterize the flow of fluids through pipes, ducts, and channels. It is defined as four times the ratio of the cross-sectional area to the wetted perimeter of the conduit.

For circular body = 4A/P = D

Yes, it is equal to for a circular pipe of diameter D.

Q.3

Sol. Given :

Stagnation pressure head, $h_s = 6\text{m}$

Static pressure head, $h_t = 5\text{ m}$

$\therefore$ $h = 6 - 5 = 1\text{ m}$

Velocity of flow, $V = C_v\sqrt{2gh} = 0.98\sqrt{2 \times 9.81 \times 1} = 4.34\text{m/s}$

Q.4

Sol. The horizontal axis about which a telescope can be rotated in a vertical plane is known as a trunnion axis.

Q.5

Sol. (a) The external focussing telescope-here the object glass moves to and for.

(b) The internal focussing telescope-here a double concave lens is geared with the focussing screw by means of a rack-and-pinion arrangement which moves to and for with the turning motion of the screw.

Q.6

Sol. Planimeter : It is an instrument used to measure plan area of any shape. It is particularly helpful when plans are of very irregular shape.

Q.7

Sol. The average time for which the biomass stays in the system is known as sludge age (θ_c) and it is given by.

$$\theta_c = \frac{\text{Mass of biomass in the system}}{\text{Mass of biomass leaving the system per day}}$$

$$\Rightarrow \quad \theta_c = \frac{200 \times 10^3 \times 2000}{50 \times 10^6}$$

$$\Rightarrow \quad \theta_c = 8\text{ days}$$

Q.8

Sol.
1. Batching
2. Mixing
3. Transportion
4. Placement
5. Compaction
6. Finishing

Q.9

Sol. The consistency of standard cement paste is defined as that consistency which will permit the Vicat plunger 50 mm long and having 10 mm diameter to penetrate to a point 5 mm to 7 mm from the bottom of the Vicat mould.

Q.10

Sol. Given: Free mean speed V_{sf} = 80 kmph, S_{jam} = 6.9 m

Jam density, $K_i = \frac{1000}{6.9}$ = 145 vehicles/km (per lane)

Maximum flow q_{max} or capacity flow, $q_c = \frac{V_{sf}K_j}{4} = \frac{80 \times 145}{4} = 2900$ vehicles/hour/per lane

Q.11

Sol.
- Kinematic viscosity depends on both dynamic viscosity and density. Air has much lower density than water, which significantly increases its kinematic viscosity.
- Kinematic viscosity of air is 15.2 times that of water at 20°C.

Q.12

Sol. Tie Bar are provided across the longitudnal joint at mid depth & it is oriented pependicular to the direction of traffic.

Dowel bars are provided across the transver joint & it is oriented along the direction of traffic. It is used to transfer wheel load to one slab to another slab.

Q.13

Sol. Water logging is a phenomena in which productivity of land gets affected due to rise in water table, thus leading to the flooding of root zone of the plants.

Q.14

Sol.
- $V = \left[\frac{Qf^2}{140}\right]^{1/6}$
- $V = 10.8R^{2/3}S^{1/3}$

Where, Q = Discharge in m^3/s, f = silt factor, R = Hydraulic radius, S = Bed slope

Q.15

Sol. Inconsistency of Record can be corrected by double - mass curve technique.

It is a graph is plotted between accumulated rainfall of station 'x' whose data is inconsistent & accumulated rainfall of average of group of base station, in reverse chronogical order.

Q.16

Sol. **Limitation of bernoulli equation:**
- We don't apply bernoulli equation near the plate surface because there is viscous force due to which energy losses occur.
- In internal flow bernoulli equation is valid only at center line in pipe flow. We don't apply bernoulli equation near the surface of pipe due to highly viscous zone.
- In external flow bernoulli equation valid outside of boundary layer.

Q.17

Sol.

$$\frac{y_2}{y_1} = \frac{-1+\sqrt{1+8F_{r_1}}}{2}$$

where y_1 & y_2 are pre and post jump depth

f_r is the froude no. for the supercritical flow.

Q.18

Sol. **A-3, B-2, C-4, D-1**

A. release valve — 3. Remove air from the pipeline

B. Check valve — 2. Limit the flow of water to single direction

C. Gate valve — 4. Stopping the flow of water in the pipeline

D. Pilot valve — 1. reduce high intel pressure to lower outlet pressure

Q.19

Sol. A concrete plant, also known as a batch plant or batching plant or a concrete batching plant, is equipment that combines various ingredients such as cement, sand, aggregates and admixtures to form concrete.

Q.20

Sol. Sludge Volume Index (SVI) is defined as the volume occupied (in mL) by 1 g of solids in the mixed liquid after settling for 30 min.

Now, MLSS = 2800 mg/L

$\therefore$ In 1 L sample,

Solids = 2800 mg

$\Rightarrow$ W = 2.8 g

and settled volume = 200 mL

Hence, $$SVI = \frac{V}{W} = \frac{200}{2.8} = 71.43$$

5 Marks

Q.21

Sol. For a given specific eneryg E,

Let discharge $= Q$

and velocity $= v$ at flow depth $= y$

$$\therefore \quad E = y + \frac{V^2}{2g}$$

$$\Rightarrow \quad E = y + \frac{Q^2}{2gA^2} \qquad [\because V = Q/A]$$

$$\Rightarrow \quad Q = A\sqrt{2g(E-y)}$$

For maximum discharge, $$\frac{dQ}{dy} = 0$$

$$\Rightarrow \quad \frac{-A}{2\sqrt{E-y}} + \sqrt{E-y}\frac{dA}{dy} = 0$$

$$\Rightarrow \quad 2(E-y)\frac{dA}{dy} = A$$

$$\Rightarrow \quad 2\left(\frac{V^2}{2g}\right)\frac{dA}{dy} = A$$

$$\Rightarrow \quad \frac{Q^2}{A^2 g}(T) = A \qquad [\because T = dA/dy]$$

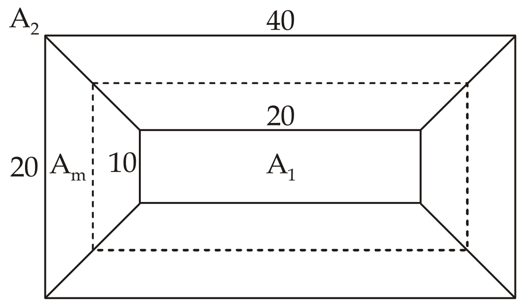
$$\Rightarrow \quad Q^2/g = A^3/T$$

Which is the condition for critical flow.

Q.22

Sol. Given :

$$\text{Depth of pit} = 5 \text{ m}$$
$$\text{Top dimensions} = 10 \text{ m} \times 20 \text{ m}$$
$$\text{Bottom dimensions} = 20 \text{ m} \times 40 \text{ m}$$



Plan of pit

We know that in prismodial rule, the number of ordinates required should be odd, but here ordinates provided are even, so average of the side are taken and A_m is calculated.

$$A_m = \left(\frac{10+20}{2}\right) \times \left(\frac{20+40}{2}\right) = 450 \text{ m}^2$$
$$A_1 = 10 \times 20 = 200 \text{ m}^2$$
$$A_2 = 20 \times 40 = 800 \text{ m}^2$$

As per prismoidal rule, volume of pit,

$$V = \frac{h}{3}[A_1 + 4A_m + A_2] \qquad \left[\because h = \frac{5}{2} = 2.5\text{m}\right]$$
$$= \frac{2.5}{3}[200 + 4 \times 450 + 800]$$
$$= 2333.33 \text{ m}^3$$

$\therefore$ Volume of pit = 2333.33 m^3

Q.23

Sol. Given, at 30°C $\quad BOD_5 = 110 \text{ mg}/l$

$$K_{20} = 0.1 \text{ day}^{-1}$$

Now, $\quad K_T = K_{20}(1.047)^{T-20}$

$\therefore \quad K_{30} = 0.1(1.047)^{30-20} = 0.158 \text{ day}^{-1}$

When T = 30°C

$$BOD_5 = L_0\left(1 - 10^{-k_{30}t}\right)$$

$\Rightarrow \quad 110 = L_0\left(1 - 10^{-0.158 \times 5}\right)$

$\Rightarrow \quad L_0 = 131.29 \text{ mg}/l$

Ultimate BOD (L_0) remains the same irrespective of temperature.

$\therefore$ When T = 20°C, $\quad L_0 = 131.29 \text{ mg}/l$

$\therefore \quad BOD_5 = L_0\left(1 - 10^{-k_{20}t}\right)$

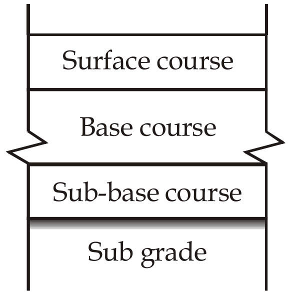
$\Rightarrow \quad BOD_5 = 131.29(1 - 10^{-0.1 \times 5}) = 89.77 \text{ mg}/l$

$\therefore \quad BOD_5$ at 20° = 89.77 mg/l

Q.24

Sol. **Flexible Pavement**

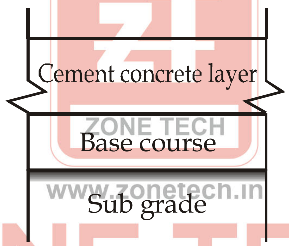
- Different Component layers are as follows



- It transfers load to lower layer by grain to grain transfer
- Flexible pavements has low or negligible flexural strength
- It is designed using IRC 37
- No expansion and contraction joints are present in flexible pavement
- Flexible pavement's construction cost is low but has high maintenance cost.

Rigid pavement

- Different component layers are as follows



- It transfer load to lower layer by slab action mechanism
- Rigid pavement has significant flexural strength
- It is designed using IRC 58
- Expansion and contraction joints are present in rigid pavement
- Rigid pavement's construction cost is high but has low maintenance cost

Q.25

Sol. Number of raingauges m $= 6$

Mean annual rainfall $\bar{P} = 118.60$ cm

Standard deviation $= \sigma_{n-1} = 35.04$ cm

(calculated by using a calculator or a spreadsheet like MS Excel).

$$\text{Coefficient of variation, } C_v = \frac{100 \times \sigma_{n-1}}{\bar{P}} = \frac{100 \times 35.04}{118.60} = 29.54$$

(a) Standard error in the estimation of the mean

$$= \varepsilon = \frac{C_v}{\sqrt{n}} = \frac{29.54}{\sqrt{6}} = 12.06\%$$

(b) When the error is limited to 10%, $\varepsilon = 10$ and the optimum number of raingauges in the catchment is given by

$$N = \left(\frac{C_v}{\varepsilon}\right)^2 = \left(\frac{29.54}{10}\right)^2 = 8.73$$

Hence, optimum number of raingauges is 9 raingauges.

Thus, the number of additional raingauges required = (9 – 6) = 3

Q.26

Sol. Syphon:-

A siphon is a long bent pipe used to carry water from a higher elevation reservoir to a lower elevation reservoir, especially when a hill or high-level obstruction lies between the two reservoirs.

Applications of Syphon:

- Irrigation and drainage over obstacles
- Emptying tanks, containers, or basins
- Hydraulics and municipal water supply
- Inverted siphons in civil structures (under roads, canals)

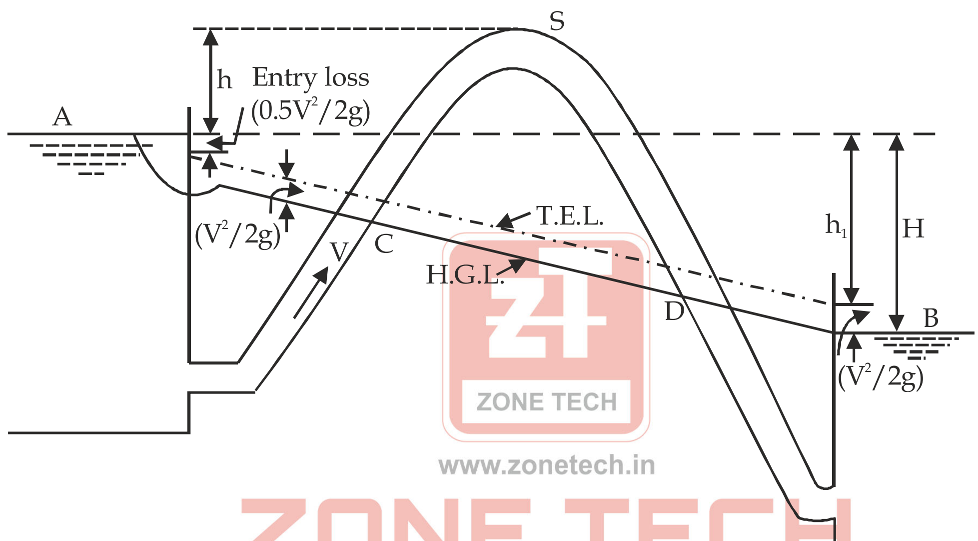


Fig.:- Siphon

Working of a Syphon:

1. **Priming:**

   The syphon pipe is initially filled with liquid (air must be removed).

2. **Flow Initiation:**

   Once filled, gravity causes the water in the longer outlet leg (SB) to fall, creating a suction effect that draws water from the upper reservoir into the pipe.

3. **Pressure Distribution:**

   •At points below C and D: Pressure is above atmospheric.

   •At points C and D: Pressure is atmospheric.

   •Between C and D (especially summit S): Pressure becomes below atmospheric (negative gauge pressure).

4. **Limitations Due to Pressure Drop:**

- Pressure at summit S can theoretically drop to –10.3m of water head (perfect vacuum), but in practice, it must not fall below 2.7m absolute pressure (≈7.6m vacuum) to avoid:

  –Air-lock formation (due to dissolved air coming out)

  –Vapor formation (causing cavitation and flow break)

5. **Flow Continues Automatically:**

   As long as outlet remains lower and no air enters, flow continues by siphon action.

Q.27

Sol. P = 3 cm
R = 1.6 cm

Trial I: Assuming i > ϕ

$$\phi = \frac{P-R}{t_e} = \frac{(3-1.6)\text{cm}}{3.5\text{ hr}} = \frac{0.4\text{cm}}{\text{hr}} = \frac{4\text{mm}}{\text{hr}}$$

Trial II: Remove i $\leq \phi$

$$\phi = \frac{P-R-\text{Pin which no excess rainfall}}{t_e}$$

$$= \frac{30\text{ mm} - 16\text{ mm} - \frac{4\text{ mm}}{\text{hr}}\times 0.5\text{ hr} - \frac{3\text{ mm}}{\text{hr}}\times 0.5\text{ hr}}{(3.5-0.5-0.5)\text{ hr}}$$

$$= \frac{10.5\text{ mm}}{2.5\text{ hr}} \Rightarrow \phi = 4.2\text{ mm / hr}$$

Q.28

Sol. Bleeding of concrete is said to occur when unreacted water in the mix tends to rise to the surface of freshly placed concrete due to sedimentation of constituents of concrete. This produces continuous capillary pores which provides a clear straight access to chemicals and deleterious materials in concrete and lowers the strength and workability of concrete.

Q.29

Sol. When a tube having a very very small diameter (capillary tubes) inserted in a large reservoir of liquid then the liquid will start to rise or fall in the tubes this effect is known as capillary effect or capillarity.

Cause :- Due to cohesion and adhesion both

Effect of contact angle (θ)**:-**

The contact angle is the angle between the liquid surface and the solid surface at the point of contact. For wetting liquids like water on glass:

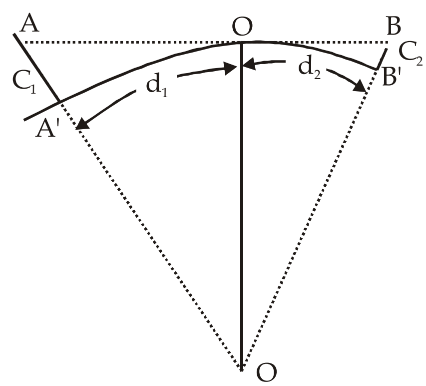
- $\theta < 90°$
- Meniscus is concave.
- Capillary rise occurs.

For non-wetting liquids like mercury on glass:

- $\theta > 90°$
- Meniscus is convex.
- Capillary depression occurs.

Q.30

Sol. Let A be the position of the top of light-house and B be the position of observer's eye. Let AB be tangential to water surface at O.



The distances d_1 and d_2 are given by

$$d_1 = 3.8553\sqrt{C_1} \text{ km}$$

$$= 3.8553\sqrt{42} = 24.985 \text{ km}$$

and $$d_2 = 3.8553\sqrt{6} = 9.444 \text{ km}$$

∴ Distance between A and B $= d_1 + d_2$

$= 24.985 + 9.444 = 34.429$ km.

Q.31

Sol. Energy Loss in Hydraulic Jump

$$h_L = E_1 - E_2$$

$$= y_1 + \frac{v_1^2}{2g} - y_2 - \frac{v_2^2}{2g}$$

$$= y_1 + \frac{q^2}{y_1^2.B^2.2g} - y_2 - \frac{q^2}{y_2^2B^2.2g}$$

$$\simeq y_1 + \frac{q^2}{y_1^2.2g} - y_2 - \frac{q^2}{y_2^2.2g}$$

$$E_L = (y_1 - y_2) + \frac{q^2}{2g}\left[\frac{1}{y_1^2} - \frac{1}{y_2^2}\right] \quad ....(i)$$

$$\frac{q^2}{g} = \frac{y_1 y_2 (y_1 + y_2)}{2} \quad ...(ii)$$

By using equation (i) & (ii) we calculate energy loss in Hydraulic Jump

$$E_L = \frac{(y_2 - y_1)^3}{4y_1y_2}$$

Q.32

Sol. Total hardness

= 5 meq/l (due to Ca^{2+} and Mg^{2+})
= (5 × 50) mg/l as $CaCO_3$
= 250 mg/l as $CaCO_3$

Alkalinity (due to HCO_3^-)

= 3.5 mg/l as $CaCO_3$
= (3.5 × 50) mg/l $CaCO_3$
= 175 mg/l as $CaCO_3$

Carbonate hardness

= Min. (total hardness, Alkalinity)
= Minimum (250, 175)
= 175 mng/l as $CaCO_3$

Non-carbonate hardness

= Total hardness – Carbonate hardness
= 250 – 175
= 75 mg/l as $CaCO_3$

20 Marks

Q.33

Sol.

(a) The functional relationship for R may be expressed as

$$R = f(\mu, \rho, D, V)$$

According to buckingm's π theorem

$$m = \text{Total number of variable} = 5$$

$$n = \text{Number of fundamental dimensions involved} = 3$$

Number of dimensionless- π -terms = m - n = 2

So,
$$\pi_1 = \left[D^a v^b \rho^c\right]\mu$$

$$\pi_2 = \left[D^a v^b \rho^c\right]R$$

Now,

$$\pi_1 = [L]^a\left[LT^{-1}\right]^b\left[ML^{-3}\right]^c\left[ML^{-1}T^{-1}\right]$$

$$M^0L^0T^0 = [L]^a\left[LT^{-1}\right]^b\left[ML^{-3}\right]^c\left[ML^{-1}T^{-1}\right]$$

$$M^0L^0T^0 = M^{c+1}L^{a+b-3c-1}T^{-b-1}$$

Now compare the power of this equation then, we get

$$c = -1, b = -1 \text{ and } a = -1$$

Put the value of a, b, and c in π_1 then we get

$$\pi_1 = (D^{-1}v^{-1}\rho^{-1})\mu = \frac{\mu}{\rho v D}$$

Now,

$$\pi_2 = \left[D^a v^b \rho^c\right]R$$

$$\pi_2 = [L]^a\left[LT^{-1}\right]^b\left[ML^{-3}\right]^c\left[MLT^{-2}\right]$$

$$M^0L^0T^0 = M^{c+1}L^{a+b-3c+1}T^{b-2}$$

Now compare the power of this equation then, we get

$$c = -1, b = -2 \text{ and } a = -2$$

$$\pi_2 = \left[D^{-2}v^{-2}\rho^{-1}\right]R = \frac{R}{\rho v^2 D^2}$$

According to buckingm's π theorem

$$fn(\pi_1, \pi_2) = 0$$

or
$$\pi_2 = fn(\pi_1)$$

So,
$$\frac{R}{\rho v^2 D^2} = fn\left(\frac{\mu}{\rho v D}\right)$$

$$\frac{R}{\rho v^2 D^2} = \phi\left(\frac{\mu}{\rho v D}\right)$$

$$\therefore \quad R = \rho v^2 D^2 \phi\left(\frac{\mu}{\rho v D}\right) = k\left(\rho v^2 D^2\right)\left(\frac{\mu}{\rho v D}\right)$$

$$R = k\mu v D$$

(b) Given D= 1 mm; V = 20 mm/s; k = 3 π

For uniform velocity of the sphere, resistance R is depend on the gravitational force and buoyancy force.

Gravitational force (mg) = Buoyancy force (f_b) + Resistance force (R)

$$R = mg - f_b$$

$$R = \rho_s v_s g - \rho_f v_{disp} g$$

∴ By substitution, we get

$$R = \frac{4}{3}\pi r^3 g\left(\rho_s - \rho_f\right)$$

$$\because \quad R = k\mu v D,\ k = 3\pi \text{ (Given)}$$

$$\therefore \quad 3\pi\mu v D = \frac{4}{3}\pi R^3 g\left(\rho_s - \rho_f\right)$$

$$6\pi\mu v R = \frac{4}{3}\pi R^3 g\left(\rho_s - \rho_f\right)$$

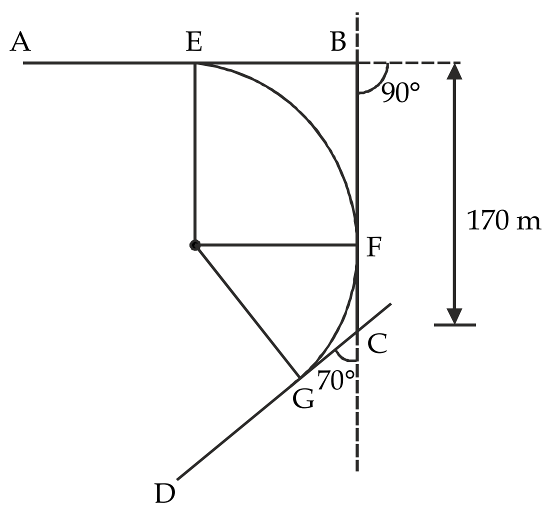
$$\mu = \frac{2}{9}\frac{R^2 g\left(\rho_s - \rho_f\right)}{v} = \frac{2\times\left(0.5\times10^{-3}\right)^2\times9.81\times(7800-910)}{9\times0.02}$$

$$= 0.1878 \text{ N.s/m}^2$$

$$= 1.878 \text{ poise.}$$

Q.34

Sol. Assuming CF = x



For curve E to F, EB is the tangent length

$$\therefore \quad EB = BF = R\tan\left(\frac{90}{2}\right)$$

or $\quad R \tan 45° = (170 - x) \quad \quad ...(1)$

For curve F to G, FC is the tangent length

$$FC = R\tan\left(\frac{70}{2}\right) = X \quad ...(2)$$

Equating x from both equation

$$170 - R\tan 45° = R\tan 35°$$

$\therefore$ $\boxed{R = 100 \text{ m}}$

Now, Length of curve EF $= \frac{\pi R\Delta}{180} = \frac{\pi \times 100 \times 90}{180} = 157.08$ m

Also, Length of curve E to G $= \frac{\pi \times R \times 70°}{180} = 122.17$ m

$\therefore$ Chainage of tangent point E $= 700 - 100 = 600$ m

Chainage tangent point F $= 600 + 157.08$

$= 757.08$ m

Chainage of tangent point G = 757.08 + 122.17

= 879.25 m

Q.35

Sol. **Necessity of sedimentation:**

Raw water contains a large amount of suspended solids as impurities. They are considered objectionable because:

(a) They make the further treatment difficult and reduces their efficiency (such as that of filtration disinfection units)

(b) They may partially shield the harmful organisms from disinfection.

(c) They may also be biologically active and may form disease causing organisms as well as organisms such as toxin producing strains of algae.

Sedimentation is considered a necessity for treating raw water because it is a natural process which helps in getting rid of a large chunk of above mentioned impurities. In this process, impurities or solids with density higher than the water settle under the action of gravity and hence are removed from the system.

Procedure of sedimentation:

Sedimentation is done with the help of large settlement basins which may be quiescent type (fill and draw type) and continuous type. In former case, the flow is essentially stopped and the particles are given enough time to settle down into the tank. Whereas in latter case, the flow velocity is reduced and length of travel is increased which helps in detaining the particles for a longer time in the sedimentation basin.

Factors affecting sedimentation are as follows:

(a) Surface over flow rate (V_s)

- It is defined as the discharge per unit surface area of sedimentation tank.
- It can be thought of as settling velocity of that particle which if introduced at the top most point at inlet will reach the bottom most point at outlet.
- Hence, smaller the surface overflow rate, larger would be the efficiency of sedimentation tank and vice-versa.

(b) Velocity of flow (V_f)

- For a given discharge, the greater the area of cross-section of flow, the lesser is the flow velocity and hence larger would be the defention time. Consequently, more will be the particles that settle down.

(c) Size and specific gravity of particles:

- Particles with larger size and specific gravity have larger settling velocities and are thus removed with greater efficiency in lesser time.

Purpose of coagulation in treatment of raw water:

- Efficiency of normal sedimentation is very low when water contains very fine suspended particles or colloids.
- Coagulants are added in such a case to reduce the forces which tend to keep colloids apart.
- Thus coagulation aids in destabilizing these colloids which can be finally agglomerated and settled down.

Baffle type of mixing basin:

The baffle type mixing basins are rectangular tanks which are divided by baffle walls. The baffles may either be provided in such a way as the water flows horizontally around their ends (as shown in figure A); or they may be provided as to make the water move vertically over and under the baffles (as shown in figure B). The hindrances and the disturbances created by the provision of baffle in the path of flow, give it sufficient agitation, as to cause necessary mixing to develop the floc.

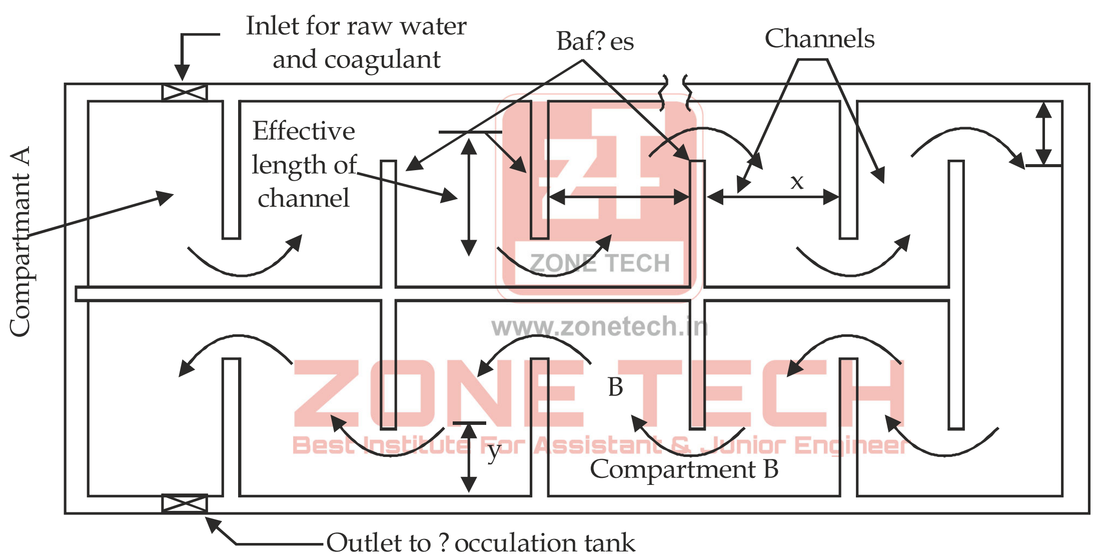


Fig. A : Plan of "Around the end baf? e type"

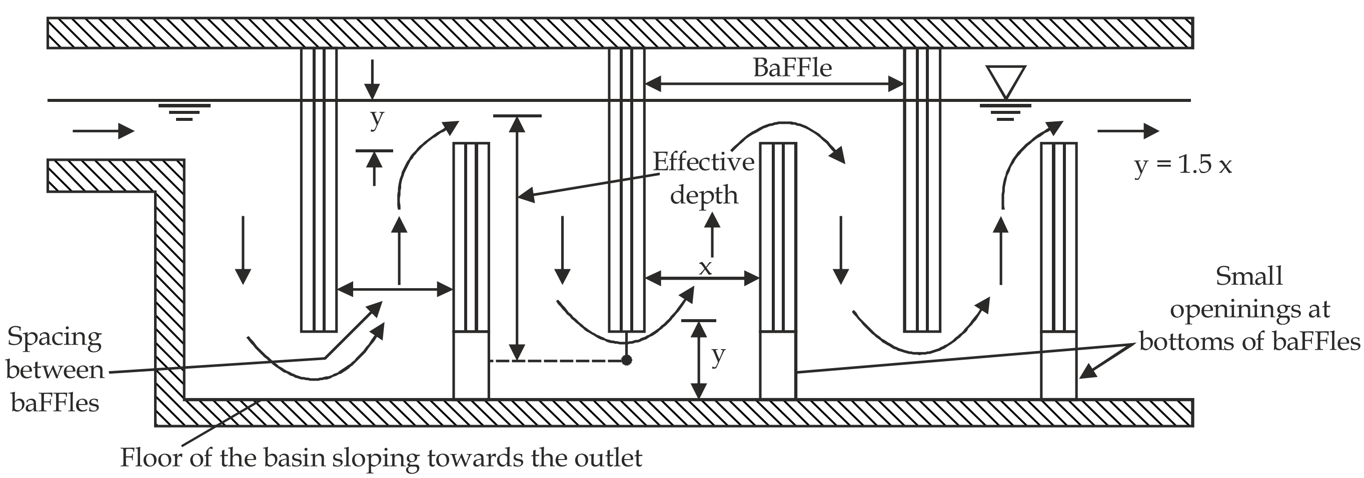


Fig. B : Sectional elevation of "Over and under the baFFle type"

Q.36

Sol. **Types Of Paints**

(1) Aluminium Paint

The very finely ground aluminium is suspended in either quick drying sprit varnish or slow drying oil varnish as per requirement. The spirit or oil evaporates and a thin metallic film of aluminium is formed on the surface.

Advantages:-

(a) It is visible in darkness.
(b) It resists heat to a certain degree.
(c) The surface of iron and steel are better protected from corrosion by this paint than any other paint.
(d) It possesses a high covering capacity.

Note:-

A litre of paint can cover about 200 m^2 area.

(e) It gives good appearance to the surface.
(f) It has high electrical resistance.

(2) Anti-corrosive paint:-

This paint essentially consists of oil and a strong drier. A pigment such as chromium oxide or lead or red lead or zinc chrome is taken and after mixing it with some quantity of very fine sand, it is added to the paint.

Advantages:-

- It is cheap.
- It lasts for a long duration.
- The appearance of this paint is black.

(3) Asbestos Paint:-

This is a peculiar type of paint & it is applied on the surface which are exposed to the acidic gases & steam.

(4) Bituminous Paint:-

- This paint is prepared by dissolving asphalt in any type of oil or petroleum.
- This paint gives a black appearance.
- It is used for painting ironwork under water.

(5) Cellulose Paint:-

- This paint is prepared from nitro-cotton, celluloid sheets, photographic films etc.
- An ordinary paint hardens by oxidation but cellulose paint hardens by evaporation of thinning agents. It thus hardens quickly.
- It is a little more costly, but it presents a flexible, hard & smooth surface.
- The surface painted with cellulose paint can be washed & easily cleaned.

(6) Cement Paint:-

- This paint consists of white cement, pigment, accelerator and other additives.
- It is available in dry power form.
- The cement paint is available in variety of shades & it exhibits excellent decorative appearance.
- It is water proof & durable.
- It proves to be useful for surface which are damp at the time of painting or are likely to become damp after painting.
- It is desirable to provide cement paint on rough surface rather than on smooth surface because its adhesion power is poor on smoothly finished surface.

(7) Luminous Paint

- This paint contains calcium sulphite with varnish.
- The surface on which luminous paint is applied shines like radium dial of watches after the source of light has been cut off.
- This paint is applied on surface which are free from corrosion.

(8) Oil Paint

- This is the ordinary paint & it is generally applied in three coats of varying composition & they are respectively termed as primes, undercoat & finishing coats.
- This paint is cheap & easy to apply

(9) Plastic Paint

- This paint contains the necessary variety of plastics & it available in the market under different trade names.
- They are applied either by brush or spray.
- This paint gives pleasing appearance & it is attractive in colour.
- Widely used in showrooms, auditorium etc.

Q.37

Sol. Given,

Speed of the vehicle = 50 km/hr

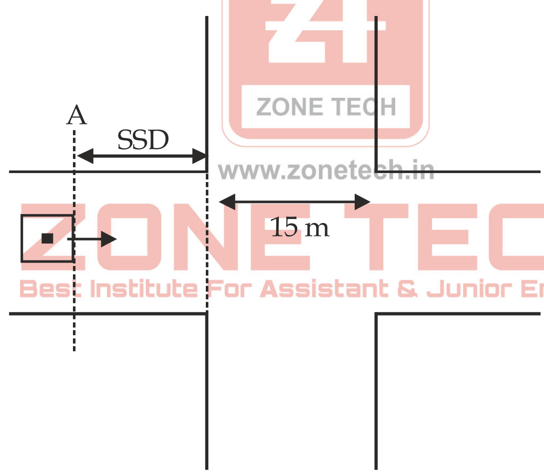
Amber duration = 4.5 sec

Comfortable deceleration = 3 m/sec^2

Car length = 4.6 m

Intersection width = 15 m

perception reaction time = 1.5 sec



When the vehicle reaches section A, he sees the amber light. Here, two situations are possible.

(i) He decides to cross the intersection:

Total distance to be covered = SSD + 15 + 4.6

SSD = Lag distance + Brake distance

$$= V \times t + \frac{V^2}{2 \times a} = \left(50 \times \frac{5}{18}\right) \times 1.5 + \frac{\left(50 \times \frac{5}{18}\right)^2}{2 \times 3}$$

= 20.83 +32.15 = 52.98 m

∴ Total distance to be covered = 52.98 + 15 + 4.6 = 72.58 m

∴ Time taken to cover this distance if vehicle travels at the rate of 50 km/hr

$$\text{Time required} = \frac{72.58}{\left(50 \times \frac{5}{18}\right)} = 5.23\,\text{sec} > 4.5\,\text{sec}$$

(ii) He decides to stop the vehicle

Time taken to stop the vehicle after sighting the amber light.

= Reaction time + time taken to stop the vehicle after application of brakes

$$= 1.5 \frac{\left(50 \times \frac{5}{18} - 0\right)}{3} = 1.5 + 4.63$$

= 6.13 sec > 4.5 sec

Therefore, in both the situations, the required duration is greater than the provided amber duration, hence the driver's claim is correct.

Q.38

Ans. **(a)** C.C.A. = 15,000 hectares.

IoI for the wheat(Rabi) = 40%

IoI For rice (Kharif) = 15%

Wheat (Rabi) area = 15,000 × 0.40 = 6000 hectares

Rice (Kharif) area = 15,000 × 0.15 = 2250 hectares

Δ for wheat = 37.5 cm.

Δ for rice = 120 cm.

B for wheat = 160 days.

B for rice = 140 days.

Now $$D = \frac{864\,B}{\Delta}$$

$$\text{Average duty (D) for wheat} = \frac{864 \times 160}{37.5} = 3686 \text{ hectares/cumec}$$

$$\text{Average duty (D) for rice} = \frac{864 \times 140}{120} = 1008 \text{ hectares/cumec}$$

$$\text{Outlet discharge required for wheat} = \frac{\text{Area}}{\text{Duty}} = \frac{6000}{3686} = 1.63 \text{ cumec}$$

$$\text{Outlet discharge required for rice} = \frac{2250}{1008} = 2.23 \text{ cumec.}$$

The required design discharge at outlet (from average demand considerations) is maximum of the two values, i.e. 2.23 cumec.

(b) Kor water depth for wheat = 13.5 cm.

Kor period for wheat = 4 weeks = 4 × 7 = 28 days

Kor water depth for rice = 19 cm.

Kor period for rice = 2 weeks = 2 × 7 = 14 days.

$$\text{Duty for wheat (for kor demand)} = \frac{864 \times B}{\Delta}$$

$$= \frac{864 \times \text{Kor period for wheat}}{\text{Kor water depth for wheat}} = \frac{864 \times 28}{13.5} = 1792 \text{ ha/cumec}$$

Duty for rice (for Kor demand)

$$= \frac{864 \times \text{Kor period for rice}}{\text{Kor water depth for rice}} = \frac{864 \times 14}{19} = 636\,\text{ha/cumec}$$

Outlet discharge required for wheat (for kor demand)

$$= \frac{\text{Area}}{\text{Duty}} = \frac{6000}{1792} = 3.35\,\text{cumec.} \quad ...(i)$$

Outlet discharge required for rice (for kor demand)

$$= \frac{2250}{636} = 3.54 \text{ cumec} \quad ...(ii)$$

The required design discharge at the outlet, from peak demand considerations, is maximum of these two values, i.e. = 3.54 cumec. **Ans.**