Q. 1. Design a isolated square footing for the column size (400x400) mm2 carrying a load of 1000kN.The safe bearing capacity of soil 250KN/m2 at depth in below fig 9.2 assume concrete grade M20, fe415.

Q. 2. A Rectangular column (600x400) mm causes an axial load of 800KN. Design a rectangle gooting to support to 200Kn/mm2 in M25, fe415.

Q. 3. Design combined footing for two column of 1000KN for column A and 1500KN for column B. Column A of size (400x400) mm2 column B of size (600x600) mm2. Distance between 2 column is 3.6m the projection from the column A is 560mm and SBC is 280KN/m2 use M25, fe415.

Q. 4 The foundation for a structure comprising six piles of square cross-section have to support a service load of 3600KN. The piles are driven through a hard startum and bear on hard rock. Design the reinforcement in pile assuming the pile to be 6m long and using M20 grade of concrete & fe415 steel HYSD bar. Sketch of reinforcement in the pile.

Q. 5. A 12m long & 300 mm diameter concrete pile is driven in uniform deposite of sand. The water table is very much low. Gamma=18KN/m3, Nq= 13.7 the safe load capacity of pile, K=2, Assume Dc=15D.

Aim:

To determine the optimum coagulant dosage for clarifying the given sample of water by using alum as the coagulant and performing the jar test experiment.

Principle:

Coagulants are used in water treatment plants
  i. to remove natural suspended and colloidal matter,
  ii. to remove material which do not settle in plain sedimentation, and
  iii. to assist in filtration.

Alum [$Al_2(SO_4)_3 . 18H_2O$] is the most widely used coagulant. When alum solution is added to water, the molecules dissociate to yield $_{2-4}SO$ and Al_{3+}. The +ve species combine with negatively charged colloidal to neutralise part of the charge on the colloidal particle. Thus, agglomeration takes place. Coagulation is a quite complex phenomenon and the coagulant should be distributed uniformly throughout the solution. A flash mix accomplishes this.

Jar test is simple device used to determine this optimum coagulant dose required. The jar test, device consists of a number of stirrers (4 to 6) provided with paddles. The paddles can be rotated with varying speed with the help of a motor and regulator. Samples will be taken in jars or beakers and varying dose of coagulant will be added simultaneously to all the jars. The paddles will be rotated at 100 rpm for 1 minute and at 40 rpm for 20 to 30 minutes, corresponding to the flash mixing and slow mixing in the flocculator of the treatment plant. After 30 minutes settling, supernatant will be taken carefully from all the jars to measure turbidity. The dose, which gives the least turbidity, is taken as the optimum coagulant dose.

Apparatus:

1. Jar test apparatus   2. Glass beakers
3. Pipette   4. Nephelometer
5. pH meter

Reagents

  1. Alum solution (1mL containing 10 mg of alum)
  2. Lime
  3. Acid/alkali

Procedure

  1. Take 1-litre beakers and fill them with sample up to the mark.

2. Keep each beaker below each paddle and lower the paddles, such that each one is about 1 cm above the bottom.
3. Find the pH of the sample and adjust it to 6 to 8.5.
4. Pipette 1, 2, 3, 4, 5, 6 mL of the alum solution into the test samples.
5. Immediately run the paddles at 100 rpm for 1 minute.
6. Reduce the speed to 30–40 rpm and run at this rate for 30 minutes.
7. Stop the machine, lift out the paddles and allow to settle for 30 minutes.
8. Find the residual turbidity of the supernatant using nephelometer.
9. Plot a graph with alum dosage along x-axis and turbidity along y-axis.
10. The dosage of alum, which represents least turbidity, gives Optimum Coagulant Dosage (O.C.D.).
11. Repeat steps 1–10 with higher dose of alum, if necessary.

Observation

Trial No.	Alum dosage in mg/L	Turbidity in NTU

Results

Optimum coagulant dosage = ...

Discussion

Questions

1. Why is alum preferred to other coagulants?
2. What is the difference between coagulation and flocculation?
3. What are coagulant aids?
4. Write the significance of pH in coagulation using alum.
5. What factors affect the sedimentation of a discrete particle setting in a quiescent liquid?

DETERMINATION OF ALKALINITY

Aim:
To determine the amount of the following types of alkalinity present in the given samples:
- a. Hydroxide alkalinity
- b. Carbonate alkalinity
- c. Bicarbonate alkalinity
- d. Hydroxide–Carbonate alkalinity
- e. Carbonate–Bicarbonate alkalinity

Principle:
The alkalinity of water is a measure of its capacity to neutralize acids. It is primarily due to salts of weak acids, although weak or strong bases may also contribute. Alkalinity is usually imparted by bicarbonate, carbonate and hydroxide. It is measured volumetrically by titration with 0.02 N sulphuric acid and is reported in terms of $CaCO_3$ equivalent. For samples whose initial pH is above 8.3, the titration is conducted in two steps. In the first step, the titration is conducted until the pH is lowered to 8.2, the point at which phenolphthalein indicator turns from pink to colourless. This value corresponds to the points for conversion of carbonate to bicarbonate ion. The second phase of titration is conducted until the pH is lowered to 4.5, corresponds to methyl orange end point, which corresponds to the equivalence points for the conversion of bicarbonate ion to carbonic acid.

Apparatus:
1. Burette   2. Erlenmeyer flask   3. Pipettes

Reagents:
1. Carbon dioxide free distilled water.
2. Phenolphthalein indicator.
3. Methyl orange indicator.
4. 0.1 N sodium thiosulphate solution
5. 0.02 N sulphuric acid.

Procedure:
1. Pipette 50 mL of sample into a clean Erlenmeyer flask (V).
2. Add one drop of sodium thiosulphate solution, if residual chlorine is present.
3. Add two drops of phenolphthalein indicator; if the pH is above 8.3, colour of solution becomes pink.
4. Titrate against standard sulphuric acid in the burette, till the colour just disappears. Note down the volume (V_1).
5. Then add two drops of methyl orange indicator, the colour turns yellow.

6. Again titrate against acid, until the colour turns to orange yellow. Note down the total volume (V₂).
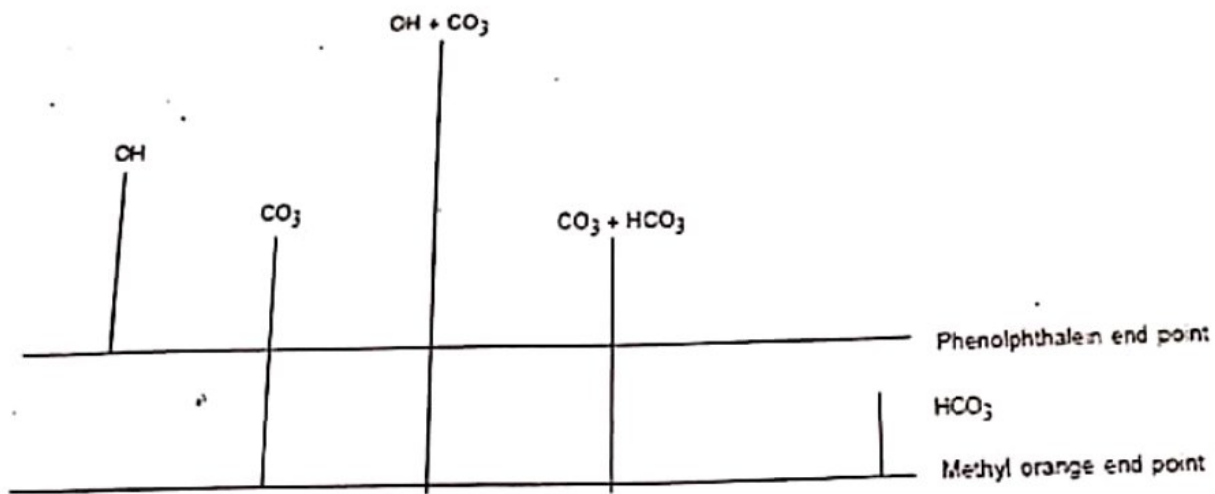
Graphical Representation of Titration of Samples Containing Various Forms of Alkalinity
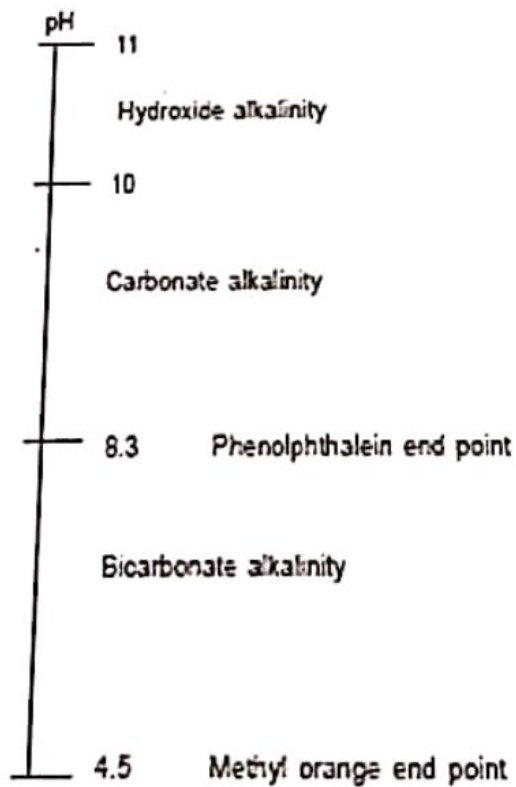
Observation

0.02 N H_2SO_4 × sample (Methyl orange/phenolphthalein indicator)

Description of sample	Trial no.	Burette reading (phenolphthalein indicator)		volume of acid used V_1	Burette reading (methyl orange indicator)		volume of acid used V_2
		initial	final		initial	final	

Calculation:

1. Phenolphthalein alkalinity (P) as mg/L $CaCO_3$ $= \dfrac{V_1 \times 1000}{mL \text{ of sample}}$

2. Total alkalinity (T) as mg/L $CaCO_3$ $= \dfrac{V_2 \times 1000}{mL \text{ of sample}}$

The types of alkalinities present in the samples are calculated using the equations given in the following table and the results are tabulated.

Result of titration	Hydroxide alkalinity as $CaCO_3$	Carbonate alkalinity as $CaCO_3$	Bicarbonate alkalinity as $CaCO_3$
P = 0	0	0	T
P < 1/2 T	0	2P	T - 2P
P = 1/2 T	0	2P	0
P > 1/2 T	2P - T	2(T - P)	0
P = T	T	0	0

DETERMINATION OF ACIDITY OF WATER

Aim:
To determine the acidity of the given sample of water.

Principle:
Acidity of water is its quantitative capacity to neutralise a strong base to a designated pH. Strong minerals acids, weak acids such as carbonic and acetic and hydrolysing salts such as ferric and aluminium sulphates may contribute to the measured acidity. According to the method of determination, acidity is important because acid contributes to corrosiveness and influences certain chemical and biological processes. It is the measure of the amount of base required to neutralise a given sample to the specific pH.

Hydrogen ions present in a sample as a result of dissociation or hydrolysis of solutes are neutralised by titration with standard alkali. The acidity thus depends upon the end point pH or indicator used. Dissolved CO_2 is usually the major acidity component of unpolluted surface water. In the sample, containing only carbon dioxide-bicarbonate carbonate, titration to pH 8.3 at 25°C corresponds to stoichiometric neutralisation of carbonic acid to carbonate. Since the colour change of phenolphthalein indicator is close to pH 8.3, this value is accepted as a standard end point for the titration of total acidity. For more complex mixture or buffered solution fixed end point of pH 3.7 and pH 8.3 are used. Thus, for standard determination of acidity of wastewater and natural water, methyl orange acidity (pH 3.7) and phenolphthalein acidity (pH 8.3) are used.

Thus, in determining the acidity of the sample the volumes of standard alkali required to bring about colour change at pH 8.3 and at pH 3.7 are determined.

Apparatus:
1. Burette
2. Pipette
3. Erlenmeyer flasks
4. Indicator solutions

Reagents:
1. CO_2 free water
2. Standard NaOH solution 0.02N
3. Methyl orange indicator solution
4. Phenolphthalein indicator solution
5. Sodium thiosulphate 0.1 N.

Procedure
1. 25 mL of sample is pipette into Erlenmeyer flask.
2. If free residual chlorine is present, 0.05 mL (1 drop) of 0.1 N thiosulphate solution is added.
3. 2 drops of methyl orange indicator is added.

4. These contents are titrated against 0.02 N hydroxide solution. The end point is noted when colour change from orange red to yellow.
5. Then two drops of phenolphthalein indicator is added and titration continued till a pink colour just develops. The volumes of the titrant used are noted down.

Observation
0.02 N NaOH × Sample (Methyl orange/phenolphthalein indicator)

SAMPLE NO.	TRIAL NO.	BURETTE READING		VOLUME OF NaOH A
		INITIAL	FINAL	

Calculation:

$$\text{Acidity in mg/L as } CaCO_3 = \frac{A \times B \times 50,000}{V}$$

where,

$A =$ mL of NaOH titrant

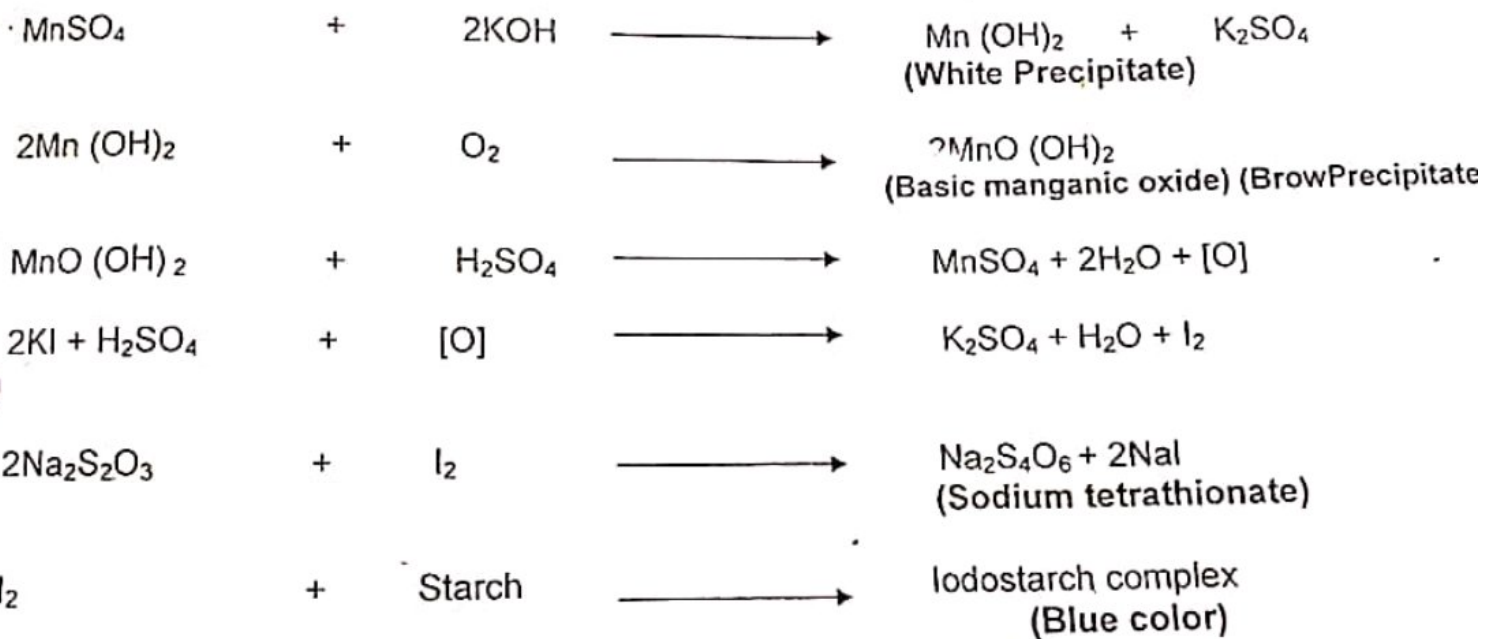$B =$ normality of NaOH

$V =$ mL of the sample

Results

SAMPLE NO.	ACIDITY IN mg/L as $CaCO_3$

Object: To determine the amount of dissolved oxygen (D.O.) present in given waste water sample.

Requirements: 250 ml DO bottle,pipette,burette,beakers,conical flask, glass rod, measuring cylinder, standard sodium thiosulphate solution ,alkaline potassium iodide solution, concentrated sulphuric acid, freshly prepared starch solution manganous sulphate solution.

Theory: The determination of DO involves the oxidantion of potassium iodide (KI) by the dissolved oxygen present in the water sample when $MnSO_4$ and alkaline KI ,(KOH + KI) is added in the water sample ,However ,dissolved molecular oxygen does not react directly with KI but require promoter for reaction to takes place, which is manganous sulphate.
The white precipitate of $Mn(OH)_2$ which is formed , is oxidized by oxygen in water sample to give a brown precipite of basic manganic oxide [$MnO(OH)_2$] [Mn^{+2} + O_2 $\longrightarrow$ Mn^{+4}] On acidification ,it gives nacent oxygen where the $MnO(OH)_2$ reverts back to Mn^{+2} slate and equivalent amount of iodine to liberated from KI present this liberated iodine is titrated against standard solution of sodium thiosulphate using starch as indicator.

Following chemical reactions are involved in the reaction.

$MnSO_4$ + 2KOH $\longrightarrow$ $Mn(OH)_2$ + K_2SO_4
(White Precipitate)

$2Mn(OH)_2$ + O_2 $\longrightarrow$ $2MnO(OH)_2$
(Basic manganic oxide) (BrowPrecipitate

$MnO(OH)_2$ + H_2SO_4 $\longrightarrow$ $MnSO_4$ + $2H_2O$ + [O]

$2KI + H_2SO_4$ + [O] $\longrightarrow$ K_2SO_4 + H_2O + I_2

$2Na_2S_2O_3$ + I_2 $\longrightarrow$ $Na_2S_4O_6$ + 2NaI
(Sodium tetrathionate)

I_2 + Starch $\longrightarrow$ Iodostarch complex
(Blue color)

Procedure:

1. Take 250 ml of water sample in a stoppered bottle avoiding contact with air.
2. Add 2 ml MnSO₄ solution to it by measns of a pipette, dipping the end well below the surface of water. Add 2 ml of alkaline – iodide – azide solution to it and stopper the bottle and shake thoroughly.
3. The brown precipitate of MnO (OH)₂ appears in bottle.
4. Allow to stand for 10 – 15 minutes, add 2 ml of concentrated H_2SO_4 carefully ,stopper add mix till the precipitate is completely dissolved and reddish brown color solution appears due to liberated iodine.
5. Take 100 ml of above solution in a conical flask and titrate it with sodium thiosulphate solution. When solution become light yellow add 3- 4 drops of starch to it.
6. Again add hypo from burette to conical flask till blue color disappears. Note the burette reading, this represents the end point.
7. Repeat the titration till we get concordant readings.

Observations:

S.No.	Volume of water sample (ml)	Burette readings		Volume of hypo used (ml)	Concordant reading(ml)
		Initial	Final		
1					
2					
3					

Calculations:

Sample water   Vs.   Hypo

N_1 V_1'   = N_2 V_2

N_1 = N_2V_2/V_1 = $N/40 \times V_2 /100$

The strength of O_2 =   Normality X   Equivalent weight of O_2

$$\frac{N}{40} \quad X \quad \frac{V_2}{V_1} \quad X \quad 8 \ X \ 1000 \ \text{mg / lit.} \quad Or \quad ppm.$$

Result: The amount of D.O. is given water sample is _____ mg / lit.   Or   ppm.

Precautions:

1. D.O. bottle should be dried and clean.
2. There should not be trapping of air bubble while filling D.O. bottles as trapped air oxygen will also contributes in chemical reaction.

1. **Object:** - To determine the Conductivity of given water samples.

2. **Requirements:** - Conductometer, Conductivity cell, thermometer, beakers, standard KCl Solution (0.01M) distilled water.

3. **Procedure:** -

i. Measurement of Cell Constant : -

1. Switch on the conductivity meter for about 15 to 20 minutes.
2. Wash the conductivity cell thoroughly with distilled water.
3. Rinse the conductivity cell with 0.01 M KCl solution.
4. Set the temperature control to the actual temperature of the solution under test.
5. Set the function switch to check position and adjust the display to 1.000 with CAL control knob of conductivity meter.
6. Dip the conductivity cell in the Standard KCl solution
7. Move the function switch to "conductance position" and select the proper range.
8. Adjust the cell constant knob value of the KCl solution at that temperature
9. Transfer the function switch to cell "constant position" and read the value of cell constant of the conductivity cell.

ii. Measurement of conductivity cell with sample of water: -

1. Rinse the conductivity cell with sample of water.
2. Set the switch to 'check' position and adjust the display to 1.000 with CAL control knob at the back panel of conductivity meter.
3. Dip the washed and dried conductivity cell in the sample of water
4. Move the function switch to "conductance" position and bring the range switch a position of maximum resolution.
5. Note the display reading as a conductivity of sample water.

4. **Observations:** -

S. No.	Water sample No.	Conductivity Gs/cm

5. **Result :** - Conductivity of given water samples are: -

OBJECT- To determine the total solid present in the given sewage sample.

Apparatus Required- Oven , Rough balance , beaker , heater

Introduction: The liquid water which includes human and house hold water, street washings , ground wastes containing mainly water and other organic and inorganic matter is called sewage. In sewage 99.9% is water and 0.1% is solid waste particles. These solid particles cab be in dissolved or undissolved form. The fine particles are in dissolved form while the suspended and colloidae particles are in undissolved state in sewage. The aerobic and anaerobic bacteria present in water oxidise the solid particles (organic and inorganic), the product form on oxidation are harmful in nature and adversly affect the quality of water. Higher one of suspended particles in laks or streams inhibit the penetration of syunlight and promote the growth of pathogen bacteria. The permissible limit of solid in sewage in 500mg/l.

So knowledge of the organic and volatile fraction of solid is necessary for the design of the biological treatment unit and for disposal of sewage by dilution.

2-The quality of inorganic and organic setteable solids helps in designing the grit chamber and sedimentation tanks respectively.

Experimental Procedure:

[A]- For total solid in sewage water

Take 50ml of sewage water and soil it ,when it is about 10ml left than transfer it in a weighed dry & clean crussible and keep the crussible. Take out the crussible from the oven with the help of tong and cool it and then weigh it.

OBSERVATION:

Weight of empty crussible = w1 gm

Weight of crussible+residue = w2 gm

Weight of residue = (w2 - w1)gm

$$= (w2 - w1) \times 1000 mg$$

➢ 50 ml of water is taken than wt. of residue = $\dfrac{(w2-w1)1000 \times 1000}{50}$ mg/ltr

Result : Weigght of total solid in sewage is _____ mg/liter.

[B] For total dissolved solid in sewage water

To determine the total dissolved solid in sewage water first we filter the sewage water with the help of what mann's filter paper no-42 (it having a special page size), the suspended and colloidal particles are left on the filter paper while dissolved solid particles are in the filtrate.

Now take 50ml of the above filtrate and repeat the same procedure.

Observation and calculation:

Weight of empty crusible = w1 gm

Weight of crusible+residue = w2 gm

Weight of residual = (w2 –w1)gm or (w2 –w1)1000mg

In 50ml filtrate of sewage weight of residue = (w2 - w1)1000mg

1000ml filtrate if taken weight of residue= $\dfrac{(w2 - w1)1000 \times 1000}{50}$ mg/lit

Result: The weight of total dissolved solid in sewage water is _____ mg/liter.

EXPERIMENT – 2, 3

OBJECT- To determine the total solid present in the given sewage sample.

Apparatus Required- Oven, Rough balance, beaker, heater

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In 50ml filtrate of sewage weight of residue = (w2 - w1)1000mg

1000ml filtrate if taken weight of residue= $\dfrac{(w2 - w1)1000 \times 1000}{50}$ mg/lit

Result: The weight of total dissolved solid in sewage water is ____ mg/liter.

Q.(1) A curved beam is in the form of full continous circle in the plan with radius of 4m and is supported continously on six supports. The beam carries an UDL of 2kN/m length. inclusive of its own weight. Determine the B.M, T.M, S.F at salient location and plot B.M, T.M and S.F diagram.

Q.(2) Design a spherical dome over a circular Room, for the following data:

(i) Inside diameter of Room = 12m

(ii) Size of dome = 4m

(iii) Live load due to wind, ice, snow etc = 1.5 kN/m²

The dome has opening of 1.6m diameter at its crown. An lantern is provided at its top, which causes a dead load of 22 kN acting along the circumference of the opening. Use M20 concrete and Fe 415.

Q.(3) Describe Joints in water tanks with their types ?

Q.(4) Design a circular tank with flexible base for capacity of 40000 liters. The depth of water is to be 4m. including a free board of 200 mm Use M 20 concrete. (with diagram)

QUANTITY AND SURVEYING VALUATION

SANJAY BISHNOI   **LAB CODE- 6CE4-24**

Q. 1. Prepare Estimate (plinth area and cubic content.)

(A) Prepare a preliminary estimate of a four storeyed office building having a carpet area of 2000 sq. m. for obtaining the administrative approval of the Government given the following data. It may be assumed that 30% of the built up area will be taken up by corridors, verandahs, lavatories, staircase etc, and 10% of the built up area will be occupied by walls.

(i) Plinth area rate is Rs. 950.00 per sq. m.

(ii) Extra due to deep foundation at site-1% of building cost.

(iii) Extra for special architectural treatment- 0.5% of building cost.

(iv) Extra for water supply and sanitary installations - 6% of building cost.

(v) Extra for electric installations - 12.5 % of building cost.

(vi) Extra for other services -5% of building cost.

(vii) Contingencies - 2.5%

(viii) Supervision charges - 8%

Q. 2. Detailed Estimate of building.

    (A) Estimate by Centre line method the quantities of following items a two roomed building

    (1) Earthwork in excavation and foundation

    (2) Lime concrete in foundation

    (3) 1st class brick work in cement mortar 1:6 in foundation and plinth

    (4) 2.5cm C. C damp proof course.

    (5) 1st class brick work in lime mortar in superstructure.

Q.3. Rate Analysis of Different items of work.

    (A) Cement concrete 1:5:10 in foundation an floor with brick ballast 40mm gauge unit 1 cubic / meter and take 10 cubic meter.

    (B) Analysis the rate for work "2.5cm cement concrete floor 1:2:4". Assume suitable rates of materials and labour.

    (C) Asbestos cement sheet celling 6mm thick, with a 40mm x 20mm teak wood beading (Excluding frame) -Unit 1sq.m. (take a room 4.50m x 6.30m area = 28.35 sq.m.).

Q. 4 Specification and Road Estimation

    (A) General specifications.

    (B) Detailed specifications.

Q. 5. Contract, tenders, and basic definations.