CIVIL ENGINEERING

Mains Paper-2 (2019)

1. (a) The velocity vector in an incompressible flow is given by

$$V = (6xt + yz^2)i + (3t + xy^2)j + (xy - 2xyz - 6tz)k$$

(i) Verify whether the continuity equation is satisfied.

(ii) Determine the acceleration in x direction at point $A(1, 1, 1)$ and $t = 1 \cdot 0$. 12

Source: MADE EASY : RIB FM Workbook : Page No. 25, Question No. 3

Question : 3 In a three dimensional flow, the components of velocity are $u = xy$, $v = 4\,yz^3$ and $w = -(yz + z^4)$. Test wheather the continuity equation for incompressible fluid flow is satisfied? Determine the acceleration vector at point (1, 1, 1).

(b) Three tube wells of 25 cm diameter each are located at the three vertices of an equilateral triangle of side 100 m. Each tube well penetrates fully in a confined aquifer of thickness 25 m. Assume the radius of influence for these wells and the coefficient of permeability of the aquifer as 300 m and 40 m/day respectively.

(i) Calculate the discharge when only one well is pumping with a drawdown of 3 m.

(ii) What will be the percent change in discharge of this well if all the three wells were to pump such that the drawdown is 3 m in all the wells? 12

Source: ESE Mains Test Series 2019, Test No. 02

Q.7 (c) (i) Three wells, each having a diameter of 10 cm are installed at the vertices of an equilateral triangle 12 m apart in a confined aquifer. The radius of influence of each well is 400 m and coefficient of permeability K is 20 m/day. The drawdown in each well is 2 m. The thickness of the confined aquifer is 15 m. Find the discharge of each well and the percentage decrease in discharge because of well interference.

(ii) Explain socket and spigot joint in cast iron pipe with figure.

[12 + 8 marks]

(d) A city has the following recorded population :

Year 1971 : 60000

Year 1991 : 120000

Year 2011 : 180000

Estimate (i) the saturation population and (ii) expected population in the year 2031 by logistic curve method. 12

Source: ESE Mains Test Series 2019 Test 02

Q.5 (c) A city has following recorded population :

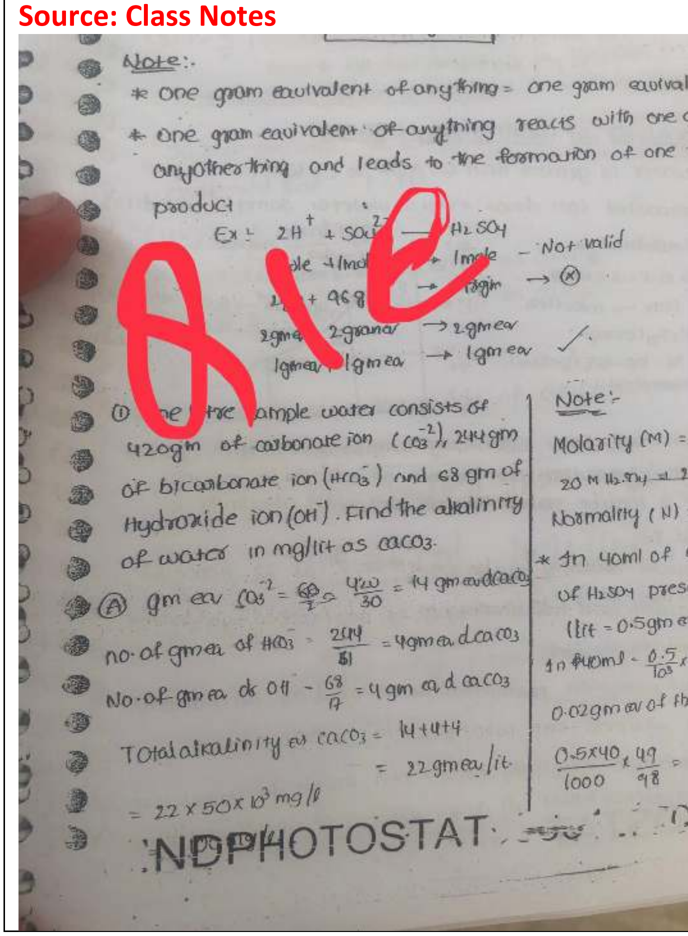
1951	50000
1971	110000
1991	160000

Estimate: (i) the saturation population, and (ii) expected population in 2011. (Use Logistic Curve Method)

[12 marks]

(e) A water contains 110 mg/L carbonate ion and 80 mg/L bicarbonate ion at a pH of 10. Calculate the alkalinity exactly at 25 °C. Approximate the alkalinity by ignoring hydroxide and hydrogen ion. What is the percentage error in approximation? 12

Source: Class Notes


Note:-

* one gram equivalent of anything = one gram equival

* one gram equivalent of anything reacts with one

anyother thing and leads to the formation of one

product

Ex:- $2H^+ + SO_4^{2-}$ → H_2SO_4

1mole + 1mole → 1mole — Not valid

2 + 96g → 98gm → ⊗

2gmeq 2gmeq → 2gmeq ✓

1gmeq 1gmeq → 1gmeq

① The sample water consists of 420gm of carbonate ion (CO_3^{-2}), 244gm of bicarbonate ion (HCO_3^-) and 68 gm of Hydroxide ion (OH⁻). Find the alkalinity of water in mg/lit as $CaCO_3$.

Ⓐ gm eq CO_3^{-2} = $\frac{60}{2}$ = $\frac{420}{30}$ = 14 gm eq of $CaCO_3$

no. of gm eq of HCO_3 = $\frac{244}{61}$ = 4gm eq of $CaCO_3$

No. of gm eq of OH = $\frac{68}{17}$ = 4 gm eq of $CaCO_3$

Total alkalinity as $CaCO_3$ = 14+4+4

= 22 gm eq/lit

= 22 × 50 × 10^3 mg/l

Note:-

Molarity (M) =

Normality (N) =

* In 40ml of H_2SO_4 ...

$\frac{0.5 \times 40}{1000} \times \frac{49}{98}$

NDPHOTOSTAT

2 (a) A trapezoidal channel is to be designed to convey a discharge of 50 m^3/sec at a velocity of 2 m/sec. The bed width to depth ratio is 0·8. The side slopes are 1 H : 1 V. Calculate the bed width, depth of flow and bed slope of the channel. Assume Manning's coefficient, $n = 0 \cdot 02$. 20

Source: Made Easy FM Workbook Page 70

Q.69 A trapezoidal channel with side slope 2 horizontal to 1 vertical is carrying a discharge of 25 m^3/sec. Given, $S_0 = \frac{1}{2500}$ and Chezy's $C = 45$. Design the channel.

(b) Define a unit hydrograph. Explain two basic assumptions made in the derivation of unit hydrograph. Following are the ordinates of a 4-hr unit hydrograph. Using this, derive the ordinates of a 12-hr unit hydrograph (do not plot the graph) :

Time (hr)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinate of 4-hr UH	0	20	80	130	150	130	90	52	27	15	05	0

What are the uses and limitations of unit hydrograph? 20

Source: ESE Mains Test Series 2019 Test 7 and Test 9

(e) Define unit hydrograph. Enumerate steps to develop a unit hydrograph from a given flood hydrograph for a catchment. The peak of a flood hydrograph due to a 6 hour storm is 470 m^3/s. The average depth of rainfall is 8.0 cm. Assume an infiltration loss of 0.25 cm/hr and a constant base flow of 15m^3/s. Estimate the peak discharge of a 6-hr UH for this catchment.

[12 marks]

Q.8 (c) Given below are the ordinates of a 4-h unit hydrograph, derive the ordinates of a 12-h unit hydrograph for the same catchment using S-curve method.

Time (hr)	0	4	8	12	16	20	24	28	32	36	40	44
Ordinate of 4-hr UH (m^3/s)	0	20	80	130	150	130	90	52	27	15	5	0

[20 marks]

(c) (i) How will you estimate the total storage capacity of a distribution reservoir? Support your answer with suitable sketches and formulae. 15

Source: Made Easy Environment Theroy Book Volume I

5.14 Design of Balancing Reservoir/Distribution Reservoir/Service Reservoir

- The main and primary function of a distribution reservoir is to meet the fluctuating demand with a constant rate of supply.
- The quantity of water required to be stored in the reservoir for equalising or balancing this variable demand against the constant supply is known as the balancing reservoir or balancing storage or the storage capacity of a balancing reservoir.
- This storage capacity of balancing reservoirs is worked out with help of hydrographs of inflow and outflow by mass curve method or by analytical tabular solution.

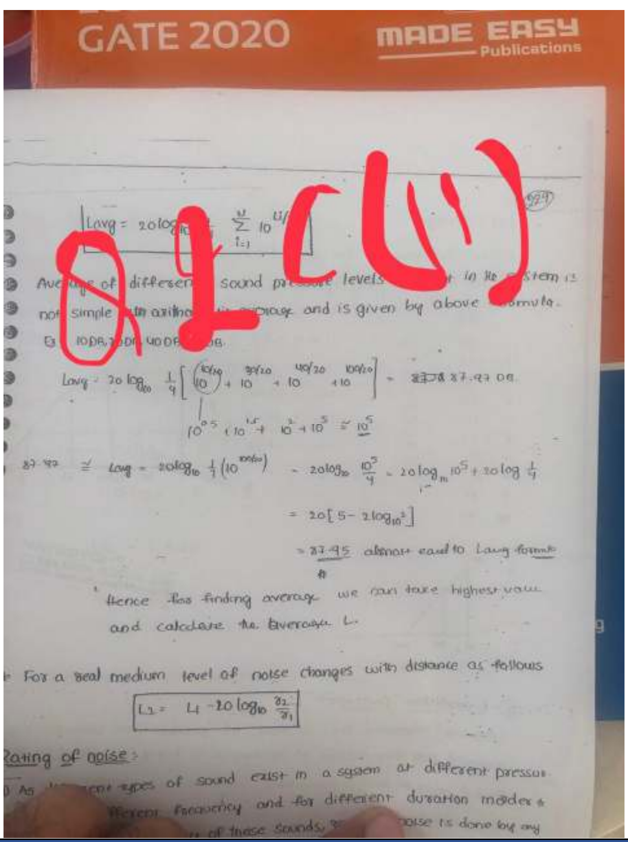
(c) *(i)* How will you estimate the total storage capacity of a distribution reservoir? Support your answer with suitable sketches and formulae. 15

(ii) Compute the average sound pressure level from the following sound pressure readings : 5

(1) 39 dBA
(2) 52 dBA
(3) 67 dBA
(4) 77 dBA

Source: RIB Page 92 Question 7

Question : 7 What sound power level results from combining the following three levels : 68 dB, 79 dB and 75 dB?



3. (a) Estimate the hydraulic gradient in a 2·2 m diameter smooth concrete pipe carrying a discharge of 3·4 cumecs at 20 °C temperature by using (i) Darcy-Weisbach formula, (ii) Manning's formula and (iii) Hazen-Williams formula. The kinematic viscosity of water at 20 °C = $1 \cdot 004 \times 10^{-6}$ m^2/sec, Hazen-Williams coefficient of hydraulic capacity of the smooth pipe = 130 and Manning's coefficient = 0·013. 20

Source: Class Notes

Q) Water is to be supplied in water supply scheme to be designed for serving population of 4 lakh. The storage reservoir is situated 8 km away from city & loss of head to the city is 16 m. Calculate the size of supply main using weisbach formula as well as hazen formula assuming max. daily demand of 200 lt/cap/day & half of the daily supply is to be pumped in 8 hrs. Assume coefficient of friction for pipe as 0.012 & hazen william constant as 130.

Total $Q = \dfrac{4\times10^5 \times 200 \times 10^{-3}}{86400} = 0.926$ m^3/sec

half supplying in 8 hrs

$\dfrac{0.926}{2} \times \dfrac{24}{8} = 1.389$ m^3/sec

$16 = \dfrac{8 \times (1.389)^2}{\pi^2 g} \times \dfrac{4 \times 0.012 \times 8000}{D^5}$

$D = 1.3$[illegible]

$v = C_D \times 0.85 \times (R)^{0.63} \times S^{0.54}$

$\dfrac{1.3[illegible]}{D^2} = [illegible] \times 0.85 \times \left(\dfrac{D}{4}\right)^{0.63} \left(\dfrac{16}{8000}\right)^{0.54}$

$D = 1.04$ m

Q) Estimate size of septic tank having L = 2.25 & depth = 2 m with 300 mm F.B. Desludging interval in years & [illegible] trench area in m^2 of the percolation field for small colony of 300 people is to be found. Assume water supply of [illegible] lt/cap/day & waste water flow at 80% water consumption. Sludge production 0.04 m^3/cap/year & Retention time of 2 days is at the coefficient = 0·06.

(b) A wastewater treatment plant consists of primary treatment clarifier followed by an activated sludge treatment unit. The primary and secondary sludge are mixed, thickened in a gravity thickener and sent to further treatment. Wastewater, treatment plant and sludge characteristics are as follows :

- Influent SS = 220 mg/L; primary clarifier diameter = 25 m
- Influent BOD = 250 mg/L; aerator volume = 3000 m^3
- Effluent BOD = 30 mg/L; MLSS in aerator = 3000 mg/L
- Flow = 20000 m^3/day; solids in thickener supernatant = negligible
- Primary sludge = 5% solids; secondary sludge = 0·75% solids and thickened sludge = 4% solids
- Efficiency of primary clarifier for SS and BOD removal are 58% and 32% respectively
- Biomass conversion factor in aerator = 0·35

Determine—

(i) solids loading in kg/day to the sludge disposal facilities;

55.39%

(ii) $\frac{F}{M}$ ratio in aerator;

(iii) percent volume reduction by the thickener.

Source: Class Notes

(Q10) Flow = 50,000 m^3/day. Raw waste water ... is assumed. Suspended solid conc.n is 400 mg/l. Efficiency of P.S.T is 35% & 75% w.r.t. BOD & S.S removal, respectively. K_{ER} = 0.06/day. Primary & secondary excess sludge, S.S concentration is 40 & 10 kg/m^3. Aeration equipment transfer capacity is 1.8 kg O_2/kW.hr. The sludge age can be adopted as 6.5. Determine,

(i) Aeration tank volume
(ii) Mass & volume of excess sludge wasted.
(iii) Sludge recirculation ratio.
(iv) " " pump capacity
(v) O_2 required
(vi) capacity of aerator.
(vii) Total sludge generated in sewage treatment plant.

Q3(b)

$$\Rightarrow \frac{1}{\theta_c} + K_{ER} = \mu \cdot y$$

$$\frac{Q_w X_u}{VX} + K_{ER} = \frac{Q_0(S_0 - S)}{VX} \cdot y$$

$$\frac{1}{6.5} + 0.06 = \frac{50,000}{8640} \left[\frac{0.65 \times 250 - 16.25}{V \times 2000}\right] 0.5 = \frac{388.25}{V}$$

Assume X = 2000 mg/l
y = 0.5
η = 85–90% of SST.

$$\eta_{BOD/PST} = \frac{Q_0 S_i - Q_0 S_0}{Q_0 S_i} \times 100$$

S_0 = 162.5 → 0.65

S = 162.5 × 0.1 = 16.25

V = 8548.78 m^3

2

(c) Explain geometric similarity, kinematic similarity and dynamic similarity. Two homologous pumps are to run at the same speed of 600 r.p.m. Pump *A* has an impeller of 50 cm diameter and discharges 0·4 m^3/sec of water under a head of 50 m. Determine the size of pump *B* and its net head if it is to discharge 0·3 m^3/sec.

20

Source: Made Easy FM Theory Book Page No. 497

Example 18.5 A one-fifth scale model of a pump was tested in a laboratory at 1000 r.p.m. The head developed and the power input at the best efficiency point were found to be 8 m and 30 kW respectively. If the prototype pump has to work against a head of 25 m, determine its working speed, the power required to drive it and the ratio of the flow rates handled by the two pumps.'

4. *(a)* Explain the terms 'initial regime' and 'final regime' as explained in Lacey's regime theory of stable channels. Design a stable channel for carrying a discharge of 30 m^3/sec using Lacey's method assuming a silt factor equal to 1·0.

20

Source: Made Easy ESE Mains Test Series 2019 Test 9

4 | ESE 2019 : MAINS TEST SERIES MADE EASY

Q.4 (a) (i) The slope of channel in an alluvium is $S = \frac{1}{5000}$; Lacey's silt factor = 0.9 and channel side slope = $\frac{1}{2} : 1\ (H:V)$. Find the channel section dimensions and maximum discharge which can be allowed to flow in it.

(b) *(i)* Define field capacity, permanent wilting point and average moisture content. Explain how these will be useful in deciding the frequency of irrigation. (A schematic diagram showing less and more frequent irrigation is to be drawn for clarity)

3+4+3=10

(ii) In a hydraulic jum...

Source: Made Easy Theory Book 29, 30

3.12.1 Osmotic Pressure

- If two salt solutions differing in concentration are separated by a semipermeable membrane (e.g., cell membrane in plant roots), water moves from the solution of lower concentration to that of higher concentration. The force with which the water moves across such a membrane is called osmotic pressure.
- Plant growth is a function of soil moisture stress.
- Osmotic pressure of a soil can be drastically reduced by controlled leaching.

3.12.2 Leaching

- Leaching is the phenomena of application of excess irrigation water in order to avoid building up of salinity in the soil.

3.13 Soil Moisture Constants

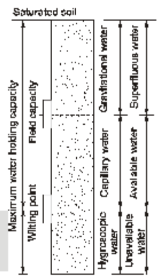


Fig. 3.4 *Classification of soil moisture*

(i) **Saturation Capacity**

- It may be defined as the total water content of a soil when 100% of the pores of soil are filled with water.
- That means it is the maximum water holding capacity of soil

NOTE: At saturation capacity, soil moisture tension in a sandy soil is almost equal to zero as in sandy soil, water is not held by the soil.

(ii) **Field Capacity (F.C.)**

- It is the amount of water content held in the soil after excess water gets drained off due to gravity and rate of downward movement has decreased.
- Physically, it can be defined as the bulk water content retained in the soil at particular hydraulic head.
- Field capacity is characterized by measuring water content after wetting a soil profile, covering it (to prevent evaporation) and monitoring the changing soil moisture in the profile.
- When the rate of changing soil moisture is very small, the water content at that point in said to be field capacity.

  Field Capacity is expressed in percentage

$$\text{Field Capacity of Soil} = \frac{\text{Weight of maximum amount of moisture held by soil against gravity}}{\text{Unit weight of the dry soil}}$$

- In medium textured soils, field capacity is about 50% of pore volume.
- Soil Moisture tension at field capacity ranges between one-tenth to one-third atmospheres.

NOTE: Saturation capacity will always be greater than or equal to the field capacity.

(ii) In a hydraulic jump occurring in a horizontal channel, the Froude's number before the jump is 10·0 and energy loss is 3·2 m. Estimate sequent depths, discharge intensity and Froude's number after the jump. 10

Source: Made Easy Workbook Page 72

Q.80 A rectangular channel 2.4 m wide carries a uniform flow of water at a rate of 7 m^3/s at a depth of 1.5 m. If there is rise of 15 cm in the bed, calculate the change in water level. What is the maximum rise in bed that will be permissible so that there will be no change in upstream depth of flow?

(c) *(i)* Explain in detail the various process parameters required to control the aerobic composting of solid waste. Discuss the relevance of each parameter also. 10

Source: Made Easy Theory Book Environment Volume II Page 268

6.3.4 Disposal of Refuse by Composting

- Composting of refuse is a biological method of decomposing solid wastes.
- This decomposition can be affected either under aerobic conditions or under anaerobic condition or both.
- The final end product is a manure, called the compact or humus.
- If the organic materials, excluding plastics, rubber and leather are separated from municipal solid wastes and are subjected to bacterial decomposition, the end product remaining after dissimilatory and assimilatory bacterial activity is humus or compost. The entire process involving both separation and bacterial conversion of the organic solid wastes is known as composting.
- Decomposition of the organic solid wastes may be accomplished either aerobically or anaerobically depending on the availability of oxygen.
- Basically, composting is considered to be an aerobic process, because it involves piling up of refuse and its regular turning, either manually or by mechanical devices, so as to ensure sufficient supply of air and oxygen during its decomposition by bacteria, fungi and other microorganisms, like antinomycetes.
- Initially, the process starts with the mesophilic bacteria, which oxidises the organic matter (in the refuse) to carbon dioxide and liberate heat. The temperature rise about 45°C and at this point, the thermophilic bacteria take over and continue the decomposition. During this phase, the temperature further rises about 60°C which has to be maintained for at least 3 days in order to destroy pathogenic bacteria. This temperature control is crucial, because optimal decomposition occurs between 55 and 60°C, but if the temperature exceeds 60°C, decomposition slows down.
- Complete stabilisation occurs after the compact is allowed to cure for another 2 to 8 weeks. During the active early decomposition phase, the thermophilic bacteria are more active during the curing stage.
- The entire composting, thus gets completed in about 3-4 months time. Volume reductions of the original organic material of up to 50% are achieved under ideal conditions. The finally produced compost usually, has earthy smell and a dark brown colour.
- Moisture content of the compost mass should, however be controlled to ensure optimum aerobic decomposition, because excessive moisture will make it difficult to maintain aerobic conditions, while deficient moisture inhabits biological life. A moisture content of about 55% should be established, so that aerobic biological activity may proceed at an optimum rate.
- Most composting operation involve three basic steps
  1. Preparation of the solid wastes.
  2. Decomposition of the soil wastes
  3. Product preparation and marketing
- Receiving, sorting, separation, size reduction and moisture and nutrient addition are part of the preparation step. Several techniques have been developed to accomplish the decompostion step. Once the solid wastes have been converted to a humus, they are ready for the third step, product preparing and marketing. This step include fine grinding, blending with various additives, granulation, bagging, storage, shipping and in some case direct marketing.
- The principal design consideration associated with the biological decomposition of prepared solid wastes are presented in table below:

SECTION—B

5. (a) A pit of 6·4 m deep is to be excavated in a fine sand stratum completely saturated up to the ground surface. The saturated unit weight of the sand was obtained as 20·3 kN/m^3. To stabilize the bottom of the excavation (prevent boiling), it was decided to drive steel sheet piles to act as cutoff walls that encircle the excavation. Determine the total length of sheet pile wall to provide a factor of safety of 1·5 against sand boiling. Assume specific gravity of soil, $G_s = 2\cdot 7$ and unit weight of water, $\gamma_w = 9\cdot 81$ kN/m^3. 12

Source: Made Easy ESE Mains Test Series 2019 : Test 15 Question 8(a) (ii)

Q.8 (a) (i) Draw plasticity chart and explain its use.

(ii) An excavation is made in a soil whose porosity is 30% and the specific gravity of soil solids = 2.6. A 1.5 m thick layer of this soil is subjected to an upward seepage head of 2 m. Find out what factor of safety exists against the piping (boiling). If a factor of safety of 2 is needed against the piping, what depth of gravel is required to be placed above the soil layer? Assume the unit weight of gravel to be the same as that of the soil and negligible loss of head in the gravel layer.

[10 + 10 marks]

(c) How are runways oriented? Explain the terms 'wind coverage' and 'crosswind component'.

Source: Made Easy Airport Engg. Theory Book Page No. 113

CHAPTER 3

Runway Design

3.1 Runway Orientation

- The orientation of runway depends upon the direction of wind and to some extent area available for development.
- Runway is oriented in the direction of prevailing wind such that the direction of wind is opposite to the direction of landing and take off.
- The head wind provides greater lift force on the wings of aircraft while taking off, thus aircraft rises above the ground earlier i.e. in a shorter length of runway.
- During landing, head wind provides greater drag force so that it comes to hault in a shorter length of runway.
- If landing and take off operation is done along the wind direction then it require longer runway.
- The wind blowing from opposite direction of head or nose of aircraft i.e., opposite to the movement of aircraft, while landing or take off is termed as head wind.
- The wind blowing in the same direction of landing or take off of aircraft is called as tail wind, it increase the stop distance or lift off distance.

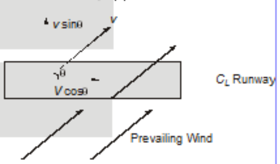


Fig. 3.1

3.2 Cross Wind Component and Wind Coverage

- It is not feasible to obtain the direction of wind along the direction of the center line of runway throughout the year.
- If the direction of wind is at an angle to runway centre line, then its components are shown in fig. 3.1.
- The normal component to movement of aircrafts is called cross wind component. It interrupts safe landing and take-off operations.
-

Type of Aircraft	Permissible limit of cross wind component
Small aircraft	15 kmph (10 mph)
Medium aircraft traffic	25 kmph (15 mph)
Big aircraft	35 kmph (23 mph)

- Centre line of the runway should not make an angle with the wind direction exceeding 30°.

(d) Calculate equilibrium cant on an MG curve of 6 degree for an average speed of 50 km/hr. Also find out the maximum permissible speed after allowing maximum cant deficiency. 12

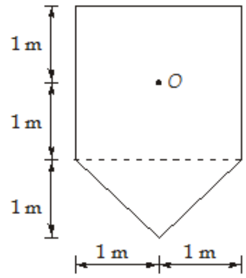
Source: Made Easy Railway Theory Book Question 9.2 Page No. 84

Example 9.2 For a 2° BG track, maximum sanctioned speed is 110 kmph, equilibrium superelevation speed 80 kmph and booked speed of goods train 50 kmph. Compute value of allowable maximum speed as well as the cant. (G = 1750 mm)

(b) Two square footings with equal contact pressure of 250 kPa are at 5 m apart (centre-to-centre). The size of the one footing (A) is 2 m×2 m and the other one (B) is 2·5 m×2·5 m. Determine the vertical stress at 2 m vertically below (i) the footing (A), (ii) the footing (B) and (iii) the midpoint between the footings. Use Boussinesq's point load formula. 10

Source: Made Easy ESE Mains Test Series 2019 : Test 1 : Question 2(c)(i)

(c) (i) Compute the vertical stress on a horizontal plane situated at a depth of 2 m below point O in the figure shown below. The area is loaded uniformly to an intensity of 300 kN/m^2. [Use Boussinesq's theory]



(d) Write down the construction steps for Water Bound Macadam road. Also compare WBM construction with WMM construction. 20

Source: Made Easy Theory Book Page No. 218

The construction of WBM roads may be divided into following steps:

(i) **Preparation of foundation for receiving the WBM course:** The foundation layer i.e. subgrade, subbase or base course is prepared to required grade and camber. On existing road surfaces, the depressions and pot holes are filled and corrugations are removed by scarifying and reshaping the surface to the required grade and camber.

(ii) **Provision of Lateral Confinement:** It may be done by constructing the shoulders to advance to a thickness equal to that of compacted *WBM* layer.

(iii) **Spreading of Coarse Aggregate:** The coarse aggregates are spread uniformly to proper profile to even thickness upon the prepared foundation.

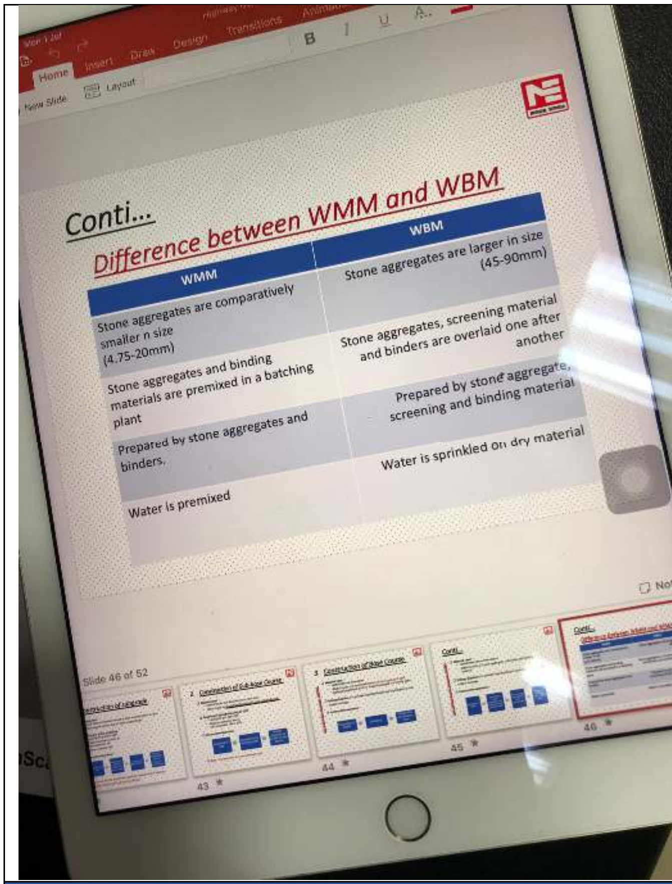
(iv) **Rolling:** Rolling is started from the edges and then gradually shifted towards the centreline of the road.

(v) **Application of screenings:** After the coarse aggregates are rolled adequately, the dry screenings are applied gradually over the surface to fill the interstices in three or more applications.

(vi) **Sprinkling and Grouting:** After screeching, the surface is sprinkled with water, swept and rolled.

(vii) **Application of Binding Material**

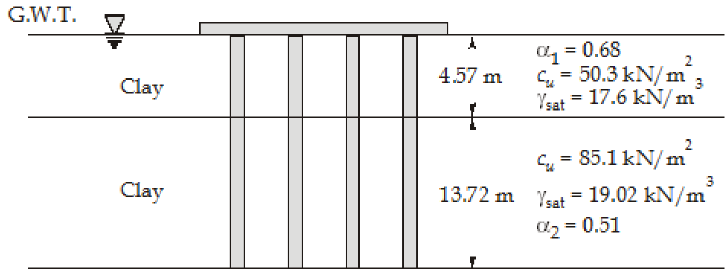
(viii) **Setting and Drying**



(b) A pile group consists of four friction piles in cohesive soil. The unit weight and unconfined compressive strength of the soil are respectively 20·2 kN/m^3 and 200 kPa. The diameter of each pile is 300 mm, length is 12·0 m and centre-to-centre spacing between the piles is 750 mm. Assuming an adhesion factor of 0·6, determine *(i)* load capacity of the group based on the individual pile failure, *(ii)* load capacity of the group based on the block failure and *(iii)* design load capacity of the group. Assume a factor of safety of 2·0 for individual pile failure and 3 for block failure. 20

Source: Made Easy ESE Mains Test Series 2019 : Test 1: Question 3(a) and Made Easy Soil Theory Book Example 16.9

Q.3 (a) The section of a 3 × 4 group pile in a layered saturated clay is shown in figure.



The piles are square in cross-section (356 mm × 356 mm). The center-to-center spacing, d of the piles is 889 mm. Determine the allowable load carrying capacity of the pile group. Use FOS = 4.

[**Note :** Ground water table coincides with the ground surface. For group action of piles take $N_c = 8.57$]

[20 marks]

Example 16.9 A pile group of 9 piles each of 500 mm dia are used for a column foundation @ 1.5 m c/c in uniform clay stratum of 10 m depth, underlain by rock. The depth of pile extend to 12 m below the surface. The average unconfined compressive strength of clay is 100 kN/m^2. Piles are arranged in a square pattern at 3 × 3. Compute the allowable load on pile group. Take FOS = 3.

Solution:

Dia. of pile = 500 mm

No. of piles in row, x = 3

(c) The following internal angles and length of sides are observed for a closed traverse *ABCDA* (in anti-clockwise direction) :

Angle	*Observed value*	*Side*	*Measured length* (m)
DAB	92°38′	*AB*	27·15
ABC	104°33′	*BC*	52·16
BCD	70°46′	*CD*	41·96
CDA	92°07′	*DA*	46·73

Adjust the internal angles for closing error. Also adjust the traverse by Bowditch method and calculate the consecutive coordinates of points *A*, *B*, *C* and *D*. Assume line *AD* in north direction. 20

Source: Made Easy Surveying Workbook

Conventional Questions

Q.11 A closed traverse has following length and bearing. Find out the closing error and correct the traverse for closing error by

(a) Bowditch method

(b) Transit method

Line	Length (m)	BB
AB	160	46°
BC	190	130°
CD	200	220°
DA	180	320°

8. *(a)* *(i)* What is spectral reflectance curve (spectral signature) in remote sensing? Explain any four applications of remote sensing in civil engineering. 10

Source: Made Easy Surveying Theory Book Page 282, 283 & Mains Test Series 2019 Test 11

18.15 Applications of Remote Sensing

1. **Agriculture**
   - (i) Early season estimation of total cropped area
   - (ii) Monitoring crop condition using crop growth profile.
   - (iii) Identification of crops and their coverage estimation in multi-cropped regions.
   - (iv) Crop yield modelling
   - (v) Cropping system/crop rotation studies
   - (vi) Command area management
   - (vii) Detection of moisture stress in crops and quantification of its effect on crop yield
   - (viii) Detection of crop violations
   - (ix) Zoom cultivation–desertification
2. **Forestry**
   - (i) Improved forest type mapping
   - (ii) Monitoring large scale deforestation, forest fire
   - (iii) Monitoring urban forestry
   - (iv) Forest stock mapping
   - (v) Wild life habitat assessment
3. **Land use and soils**
   - (i) Mapping land use/cover (level-III) at 1 : 25000 scale or better
   - (ii) Change detection
   - (iii) Identification of degraded lands/erosion prone areas
   - (iv) Soil categorization
4. **Geology**
   - (i) Lithological and structural mapping
   - (ii) Geomorphological mapping
   - (iii) Ground water exploration
   - (iv) Engineering geological
   - (v) Geo-environmental studies
   - (vi) Drainage analysis
   - (vii) Mineral exploration
   - (viii) Coal fire mapping
   - (ix) Oil field detection

Q.6 (a) Explain with the help of a neat sketch, an idealized remote sensing system.

[20 marks]

(ii) A simple circular curve of radius 30 chain length has been set out to connect two tangents with external deflection angle of 30°. The chainage of point of tangency is 300 chains. On further inspection, it is proposed to alter the radius of curve to 45 chain length. Calculate the chainage of point of curve and point of tangency for revised curve. Also calculate the length of long chord for revised curve. (Chain length = 20 m) 10

Source: Made Easy Surveying Workbook Question 9 :

MADE EASY Publications — Workbook | 81

(a) 80.4, 600.0 (b) 600.0, 80.4
(c) 600.0, 39.89 (d) 49.89, 300.0
[GATE: 2007]

Conventional Questions

Q.9 Two tangents interesect at a chainage 70.85 (70 chain 85 links). The deflection angle being 70°. Calculate the necessary data to set out a circular highway curve of 20 chain radius to connect two tangent by the method of offset from chords. Take 20 m chain length (100 links)

Q.10 Two tangent interesect at chainage 1054 m the deflection angle being 45° compute the data to set out a simple curve of radius 400 m by deflection angle and offsets. Take 30 m chord length in general beidge (1 Theodolite)

■■■■

(c) A two-lane, two-way highway is designed for design speed of 80 km/hr. A vertical curve is to be provided at intersection of downward gradient of 1 in 50 with another downward gradient of 1 in 20. Calculate the length of the vertical curve fulfilling the requirement of stopping sight distance and overtaking sight distance. The coefficient of longitudinal friction and the acceleration may be taken as 0·35 and 3·6 km/hr/sec respectively. 25

Source: ESE Mains Test Series 2019 : Test 13 : Q.7(c)(i)

8 | ESE 2019 : MAINS TEST SERIES MADE EASY

(c) (i) A valley curve is to be designed for a descending gradient of 1 in 20 meeting an ascending gradient of 1 in 40. Calculate the total length of valley curve and check for maximum impact factor, if the design speed is 80 kmph.
[Assume stopping sight distance = 120 m and $c = 0.6\ \text{m/s}^3$]

Sources : Made Easy ESE Mains Test Series 2019, Made Easy Pre and Mains Workbook, Made Easy Theory Book, Class Notes, RIB Workbook.