

MIZORAM PUBLIC SERVICE COMMISSION

DEPARTMENTAL EXAMINATIONS FOR AE/SDO (CIVIL)

UNDER PUBLIC WORKS DEPARTMENT. FEBRUARY, 2016.

CIVIL ENGINEERING PAPER – I

Time Allowed : 3 hours

FM : 100 PM : 40

Marks for each question is indicated against it.

Attempt all questions.

PART 1

1. Answer any 5 (five) of the following (5×4=20)

- (a) Design a septic tank for a colony of 200 persons with average daily sewage flow of 100 litres per head per day with the following data. (Take Detention period of 24 hrs). The design of volume of the septic tank shall be checked based on the following:
- (i) Sedimentation volume for a clear space 37.5cm deep
 - (ii) Scum Storage = 0.01cu.m per capita
 - (iii) Sludge Digestion = 0.028 cu.m per capita
 - (iv) Sludge Storage = 0.037 cu.m per capita
- (b) A short RCC column 400mmx500mm is to carry a factored load of 3000 kN having a minimum eccentricity of $< 0.05 D$ (D being smaller size of column). Design the column using M20 grade concrete and HYSD bars. The diameter and spacing of lateral ties as per IS 456:2000 should also be mentioned. Sketch of the final design shall be clearly shown in a diagram.
($P_u = 0.4f_{ck} \cdot A_c + 0.67 \cdot f_y \cdot A_{sc}$)
- (c) A simply supported rectangular beam of 6m span carries a factored load of 24 kN/m inclusive of its selfweight. The beam section is 230mmx600mm overall. The materials are M20 grade concrete and HYSD reinforcements of Fe 415. Find out the area of steel required at the midspan only. Use 20mm dia bars with clear cover of 30mm for calculation of steel.
- (d) A simply supported one-way slab of clear span 3.0m is supported on masonry walls of thickness 350mm. Find out the depth required and steel required at the midspan of the slab. Take floor finish and live loads 1 kN/m² and 2 kN/m² respectively. Use M20 concrete and HYSD Fe415 steel reinforcements.
- (e) Compute the intensities of active and passive earth pressures at a depth of 8m in dry cohesionless sand with angle of internal friction $F = 30$ degree and unit weight $g = 18$ kN/cu.m.
What will be the intensities of active and passive pressures if the water level rises to the ground level? Take saturated unit weight of sand $g_{sat} = 21$ kN/cu.m and unit weight of water $g_w = 10$ kN/cu.m [$K = (1 - \sin F) / (1 + \sin F)$]
- (f) A square footing 2.50m x 2.50m is built in a homogenous bed of sand ($c = 0$) of density $g = 20$ kN/cu.m having angle of shearing F of 36 degrees. The depth of the base of the footing (D) is 1.50m below the ground surface. Calculate the bearing capacity with a Factor of Safety (F) of 3 against complete shear failure and find out the safe load that can be carried by the footing. Use Terzaghi's equation $q_{nf} = [(c \cdot N_c + gD(N_q - 1) + 0.50BN_g) + gD] / F$ (for $F = 36$ degree, $N_c = 65.40$, $N_q = 49.40$ and $N_g = 54$)

- (g) What is the expression for minimum depth of foundation based of Rankine's theory? A soil is having intensity of loading 180kN/m^2 , density of 18 kN/cu.m and angle of shearing 30 degree . Find out the minimum depth of footing required based on Rankine's theory.

2. Give short answers to the following

(15×1=15)

- (a) What size of aggregate divide the coarse aggregate from fine aggregate?
- (b) Why is round shape used for reinforcement bars?
- (c) What is segregation in concrete undesirable?
- (d) What is the effect of temperature on concrete?
- (e) What is target mean strength in mix design of concrete?
- (f) Why is the concrete cover to reinforcements required?
- (g) What is the difference between short and long columns?
- (h) What are the various kinds of pipes available for use in water supply system?
- (i) Why is corrosion a great significance in connection with water supply pipes?
- (j) Why is turbidity in water considered objectionable?
- (k) What role does sand gravel play on filter?
- (l) What is the factor of safety usually adopted in determining the bearing capacity of soil?
- (m) What is meant by Atterberg's limits?
- (n) What is the advantage of passive pressure in retaining wall design?
- (o) What is the main difference between compaction and consolidation?

3. Choose the correct answer:

(15×1=15)

- (a) The object of temperature bars is to resist
 - (i) Deformation
 - (ii) Elongation
 - (iii) Shortening
 - (iv) Cracking
- (b) T-beams consist of slab and beam _____ casted.
 - (i) rigidly
 - (ii) unitedly
 - (iii) compositely
 - (iv) monolithically
- (c) The relation between tread T and riser R in a staircase is given by
 - (i) $R+2T = 300$
 - (ii) $2T+R = 450$
 - (iii) $T+2R = 600$
 - (iv) $2R+T = 600$
- (d) Reinforcement bars in column should not have diameter less than
 - (i) 16mm
 - (ii) 12mm
 - (iii) 10mm
 - (iv) 8mm
- (e) As per IS:13920 (1993), ductile detailing for seismic forces, to avoid a sudden collapse by tension failure, the minimum tension steel ratio in beams is :-
 - (i) $0.24 \frac{f_{ck}}{f_y}$
 - (ii) $0.25 \frac{f_{ck}}{f_y}$
 - (iii) $0.24 \frac{f_y}{f_{ck}}$
 - (iv) $0.25 \frac{f_y}{f_{ck}}$
- (f) Hardness of water is due to salts of calcium and _____
 - (i) Sodium
 - (ii) Alumina
 - (iii) Magnesium
 - (iv) Potassium
- (g) Slow sand filter is a/an _____ water tank basin in which filtering materials are placed.
 - (i) Overground
 - (ii) Underground
 - (iii) Surface
 - (iv) none of the above

- (h) Filtration is performed by a _____ biological film formed at top of the filter sand.
- (i) thin
 - (ii) thick
 - (iii) small
 - (iv) fine
- (i) The type of pipes used in service connection are usually
- (i) Hume Pipe
 - (ii) GI Pipe
 - (iii) CPVC Pipe
 - (iv) CI Pipe
- (j) Manhole for inspection and cleaning in sewer systems are located at points where
- (i) Flow of sewage is expected most severe
 - (ii) It is convenient to construct
 - (iii) There is change in direction, pipe size or grade
 - (iv) It is not easily accessible to general public for safety
- (k) The index that is used to indicate the consistency of undisturbed soils in the field is
- (i) Plasticity index
 - (ii) Liquidity index
 - (iii) Toughness index
 - (iv) Sensitivity index
- (l) If the plasticity index of a soil sample is less than 7, the soil may be classified as
- (i) Highly plastic
 - (ii) Medium plastic
 - (iii) Low plastic
 - (iv) Non- plastic
- (m) Darcy's law on permeability of soil is valid strictly for
- (i) Fine grained soils
 - (ii) Coarse grained soils
 - (iii) Mixed grained soils
 - (iv) None of the above
- (n) Under passive earth pressure, backfill behind the retaining wall is in the state of
- (i) Compression
 - (ii) Tension
 - (iii) Rest
 - (iv) Compression and tension alternatively
- (o) In bridge foundation, if there is a comparatively deep scour, type of foundation normally adopted is
- (i) Under reamed piles
 - (ii) Pre-stressed piles
 - (iii) Piles in a group
 - (iv) Well foundation

PART II

4. Answer any 5 (five) of the following (5×5=25)
- (a) Distinguish between Ashlar Masonry and Random Rubble Masonry and draw sketches to illustrate the difference.
 - (b) Write a note on various defects in brickworks.
 - (c) A simply supported beam of span 5m is carrying uniformly distributed load of 5 kN/m and a concentrated load of 10kN at the midspan. Draw the Bending Moment Diagram, Shear Force Diagram and Support Reactions and indicate the values.
 - (d) Calculate the Moment of Inertias of a rectangular section of 300mmx500mm about its centroidal axes (about x-x and y-y).

(e) Calculate the cost index to be adopted for building works based on the following data.

S/No	Component	Unit	Unit Cost as on 1.4.2012	Unit Cost as on 1.4.2015	Weightage of Component in %
1	Bricks	1000 nos	6000.00	11000.00	8.00
2	Cement	qtl	700.00	840.00	14.50
3	Steel	Qtl	3500.00	5000.00	19.50
4	Aggregate	cu.m	1000.00	1300.00	6.50
5	Sand	cu,m	1200.00	1500.00	3.00
6	Floor Tiles	Sq.m	1700.00	2015.00	3.00
7	Paints	Litre	85.00	115.00	3.00
8	Wood boards	Sq.m	450.00	635.00	5.00
9	Pipes	Rm	125.00	145.00	2.50
10	Bulbs & Fans	Nos	750.00	1065.00	3.50
11	Machinery & Pumps	Nos	35000.00	42000.00	2.50
12	Wires	Rm	76.00	98.00	4.00
13	Unskilled labours	No	150.00	200.00	10.00
14	Semi Skilled labours	No	160.00	220.00	3.00
15	2nd Class Mason	No	200.00	300.00	5.00
16	Ist Class Mason	No	250.00	350.00	7.00

(f) Prepare Analysis of Rates for “*1 : 4 cement mortar (1 cement: 4 fine sand)*” and use the analysed rate found out for analysis of rates for “*First class brickworks in foundation upto one storey above and below ground level including curing etc complete in 1 : 4 cement mortar (1 cement: 4 fine sand)*” ”Unit cost as on 1.4.2015" in Question No. 5 may be used for basic rates of materials and labours.

Coefficients to be used in the analysis are as follows:

I. Cement mortar 1:4

- (a) Cement – 0.38 ton
(b) Ist class mason – 0.07
(c) Semi skilled – 0.75

II. Ist class brick ...

- (a) Bricks – 494 nos
(b) Cement mortar – 0.25m³
(c) Ist class mason – 0.36
(d) 2nd class mason – 0.36
(e) Semi skilled – 0.20
(f) Unskilled – 1.37

5. Answer the following

(5×2=10)

- (a) Write down the defects that can arise in plastering.
(b) What are the chief chemical constituents of Portland Cement?
(c) What does Floor Area Ratio indicate in the site analysis for building construction?
(d) Define Poisson's Ratio and its significance.
(e) What is the principle of limiting the height of constructing brick masonry wall for a day?

6. Choose the correct answer.

(15×1=15)

- (a) Fungi attack timber only when :-
(i) Seasoning of timber is not done sufficiently
(ii) There is sunlight in presence of air
(iii) Left in air and warmth unseasoned
(iv) None of the above
- (b) The rubbing down of the surface after the first coat of paint is applied is called :-
(i) Stopping (ii) Brushing
(iii) Knotting (iv) Spraying
- (c) The exposed vertical surfaces left on the sides of an opening after fitting frames for door or window in position are :-
(i) Reveals (ii) Throating
(iii) Gable (iv) Tothing
- (d) From comfort point of view, the number of steps should generally be :-
(i) Not more than 10 and not less than 6
(ii) Not more than 12 and not less than 3
(iii) Not more than 13 and not less than 10
(iv) Not more than 6 and not less than 3
- (e) The worst fire resisting building material among the following is :-
(i) Stone (ii) Bricks
(iii) Concrete (iv) Gypsum
- (f) From utility point of view, of the same area, the better shape of a room is :-
(i) Square (ii) Rectangle
(iii) Elongated rectangular (iv) All of the above
- (g) Since most women use the kitchen for more than 6 hours a day, the kitchen should be planned in such a way that :-
(i) Main window faces east and others towards north
(ii) Main window faces north and others towards east
(iii) Main window faces either east or west
(iv) Main window faces south and others towards east
- (h) If two forces of magnitude 3 kN and 4 kN act at right angles to each other, the resultant force will be
(i) 1 kN (ii) 5 kN
(iii) 7 kN (iv) 9 kN
- (i) "It is not necessary to include detailed dimensions while constructing free body diagram since it is not yet needed at this stage of the analysis". The statement is :-
(i) True (ii) Not always true
(iii) False (iv) None of these
- (j) The position of a particle moving along a straight line is defined by the relation,
 $x = 2t^3 - 12t^2 - 40t + 50$, where 'x' is in meters and 't' in second. The acceleration of a particle at $t = 2$ sec is :-
(i) 0 (ii) 12 m/sec^2
(iii) 24 m/sec^2 (iv) 36 m/sec^2

- (k) The effective length of a column of length 'L' with two fixed ends is :-
- (i) 2 L
 - (ii) L
 - (iii) 0.5 L
 - (iv) 1.5 L
- (l) First class brick when immersed in water for one hour should not absorb water more than:-
- (i) 1/3 of their weight
 - (ii) 1/4 of their weight
 - (iii) 1/5 of their weight
 - (iv) 1/6 of their weight
- (m) For all wall thickness, the bond considered to be the strongest is:-
- (i) Flemish bond
 - (ii) English bond
 - (iii) Facing bond
 - (iv) Stretcher bond
- (n) A covering of stone, concrete, brick or terracotta placed on the exposed top of a wall to prevent seepage of water is :-
- (i) Corbel
 - (ii) Cornice
 - (iii) Coping
 - (iv) Gable
- (o) A retaining wall built parallel to the centre line of road is called :-
- (i) Breast wall
 - (ii) Revetment wall
 - (iii) Return wall
 - (iv) Toe wall

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