ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2013
EXAMINATION CATEGORY: <u>TECHNICAL</u>

PAPER III: SUBJECT SPECIALIZATION PAPER for *CIVIL ENGINEERING*

Date	: 14 October 2013
Total Marks	: 100
Examination Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to examination time)

GENERAL INSTRUCTIONS:

1. Write your Roll Number clearly and correctly on the Answer Booklet.

2. The first 15 minutes is being provided to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.

3. This paper consists of **TWO SECTIONS**, namely SECTION A and SECTION B:
   - **SECTION A** has two parts: Part I   -   30 Multiple-Choice Questions
                                       Part II   -   4 Short Answer Questions

     All questions under SECTION A are COMPULSORY.

   - **SECTION B** consists of two Case Studies. Choose only ONE case study and answer the questions under your choice.

4. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating any or correct Section, Part and Question Number will NOT be evaluated and no marks would be awarded.

5. Begin each Section and Part in a fresh page of the Answer Booklet.

6. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.

7. Use of any other paper including paper for rough work is not permitted.

8. You are required to hand over the Answer Booklet to the Invigilator before leaving the examination hall.

9. This paper has **10** printed pages in all, including this instruction page.

GOOD LUCK!

SECTION A
PART I - Multiple Choice Questions (30 Marks)

Choose the correct answer and write down the letter of the correct answer chosen in the Answer Booklet against the question number. E.g. 31 (c). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. For the laminar flow through a pipe, the shear stress over the cross section

    a) varies directly as the distance from the surface of the pipe
    b) varies inversely as the distance from the center of the pipe
    c) varies directly as the distance from the center of the pipe
    d) remains constant over the cross section

2. A frame, which has got more number of members than given by the formula n = (2j-3), is called a

    a) perfect frame
    b) redundant frame
    c) deficient frame
    d) RCC frame

3. Cause for the secondary consolidation is:

    a) Creep
    b) Hydrostatic pressure
    c) Hydrodynamic pressure
    d) Expulsion of absorbed water

4. SPT number is generally corrected for:

    a) Overburden pressure only
    b) Dilatancy only
    c) Both a and b
    d) None of the above

5. A simply supported beam is subjected to a uniformly distributed load of intensity w/m throughout the length of the span. The Bending Moment diagram will be:

    a) Triangle with $wl^2/8$ max. ordinate
    b) Parabola with $wl^2/8$ max. ordinate
    c) Rectangle with uniform ordinate of $wl^2/8$
    d) Parabola with $wl^2/4$ max. ordinate

6. Super elevation + lateral friction should not be greater than

    a) $V^2/225$ R
    b) $V^2/127$ R
    c) $V^2/7.4$ R
    d) $V^2/14.28$ R

7. To obtain workable concrete, what would be the minimum water-cement ratio:

    a) 0.7
    b) 0.65
    c) 0.55
    d) 0.4

8. What type of Piles are used in the construction of coffer dams:

    a) friction piles
    b) Bearing piles
    c) Sheet piles
    d) Compaction piles

9. A 50 kg bag of cement will have a Volume of?

    a) 0.0255 m^3
    b) 0.0345 m^3
    c) 0.0455 m^3
    d) 0.0500 m^3

10. Which one of the following is NOT TRUE about Critical Path Method:

    a) Uses activity oriented network
    b) Probabilistic model concept is used
    c) Used extensively in construction projects
    d) Duration of activity may be estimated with fair degree of accuracy

11. The main factor responsible for sedimentation of a particle is

    a) Specific gravity of the particle
    b) Specific gravity of the medium
    c) Difference of specific gravity of medium and particle
    d) Sum of specific gravity of medium and particle

12. The tool used by the masons to check the verticality of walls/ columns is

    a) Square
    b) Spirit level
    c) Nicker
    d) Plumb bob

13. The minimum percentage of tension reinforcement in RCC beams is

    a) $85/f_y$
    b) 0.4
    c) 4
    d) $40S_v/f_yd$

14. In rolled steel beams, shear force is resisted by :

    a) Web and flanges together
    b) Flanges only
    c) Web only
    d) Top flange only

15. When the staff is held on a B.M of RL 1000.000, the staff reading was 2.000m. When the staff is held on station Q, the reading was 3.000. Hence what would be the height of the instrument?

    a) 1000.000
    b) 1002.00
    c) 1003.00
    d) 999.000

16. The factors which influence the bond strength are:

    a) Deformed bars
    b) High grade of concrete
    c) Smaller bar diameter
    d) All of the above

17. The disadvantage of steel as structural material is:

    a) Need of fire proof treatment
    b) less construction time
    c) high strength
    d) less corrosive when exposed to environmental condition

18. Which of the following element improves the tensile strength of the steel and decrease ductility?

    a) Nickel
    b) Chromium
    c) Carbon
    d) Vanadium

19. The fundamental period of a building is dependent on:

    a) Mass and stiffness
    b) Type of structure
    c) Weight of the building
    d) Building configuration

20. The road damage is mainly caused by

    a) Faulty construction
    b) Excessive use of it
    c) Improper drainage
    d) Natural calamities

21. When a point load is applied at the corner of a reinforced concrete slab it is also felt at the center of it. Why does it happen?

    a) Modulus of elasticity
    b) Creep
    c) Fatigue
    d) Poison's ratio

22. The main assumption in reinforced concrete structure is

    a) At any cross section plane sections before bending remains plane even after bending
    b) Concrete is poor in tensile strength
    c) Neutral axis remains constant
    d) None of the above

23. The maximum ruling gradient in a steep terrain like Bhutan is

    a) 1:10
    b) 1:12
    c) 1:9
    d) 1:7

24. Which loads will govern the design of a single storey structure?

    a) Earthquake
    b) Wind
   c) Dead load and Live load
    d) None of the above

25. The deformation of a structural component increases without increase in load and even collapse under constant load. Such failure is known as:

   a) Fatigue
   b) Shrinkage
   c) Creep
   d) All of the above

26. For a building to be a seismic resistant the components such as beams and columns must have adequate:

   a) Strength
   b) Ductility
   c) Capacity
   d) All of the above

27. All structural components of the buildings must be designed as:

   a) Under-reinforced section
   b) Over reinforced section
   c) Balanced section
   d) None of the above

28. If Ix and Iy are the moment of inertia of a hollow circle section along x and y axis, their values are:

   a) Ix =Iy
   b) Ix>Iy
   c) Ix<Iy
   d) None of the above

29. If the springs with stiffness K_1 and K_2 are connected in series then the resultant stiffness (K) is equal to:

   a) $K = k1 + k2$
   b) $\frac{1}{K} = \frac{1}{K1} + \frac{1}{K2}$
   c) $K = \frac{1}{K1} + \frac{1}{K2}$
   d) None of the above

30. The process of determining the positions, both in plan and elevation, of the natural and man artificial features of a locality for the purpose of delineating them by means of conventional signs is called:

   a) Route Surveying
   b) Topographic Surveying

c) Mine Surveying
d) All of the above

PART – II : Short Answer Questions (20 marks)

Answer ALL the questions. Each question carries 5 marks. Mark for each sub-question is indicated in the brackets.

1. Answer the following two questions   (2 x 2.5 = 5 marks)
   a. Sketch the influence line for Reaction at A for a cantilever
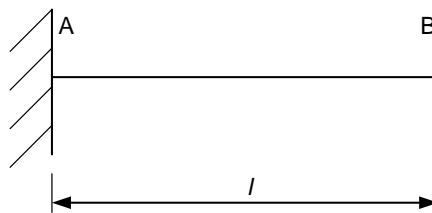
   b. Draw Shear Force Diagram for the udl of W/m acting on the beam shown below:
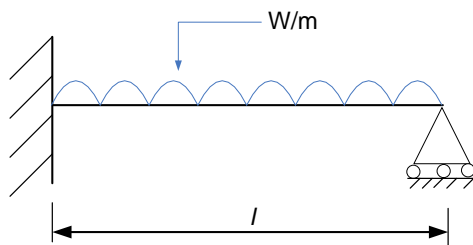
2. Answer the following two questions   (2 x 2.5 = 5 marks)
   a. In the geometric design of highways/roads, what are the five different layers? Name and sketch the layers in order.
   b. Why are cambers provided in roads, give three reasons?

3. Explain why concrete material has gained the status of the most widely used construction materials in Bhutan.   (5 marks)

4. What is meant by bulking of sand? Explain it with graphical representation and its implication on engineering practices.   (5 marks)

SECTION B
Case Study

Choose either Case 1 or Case 2 from this Section. Each Case carries 50 marks. Mark for each sub-question is indicated in the brackets.

CASE 1

Hydropower Sector is backbone of Bhutan's economy. Currently, Punatshangchu I & II, and Mangdichhu Hydropower Power Projects are under construction. Assume that you work for one of the Hydropower Projects. As a part of your Report to be submitted to the Project Management, answer the following questions.

   a. What are PFR, DPR and CDM?   (3 marks)

   b. What is concrete Gravity Dam?   (2 marks)

   c. What kind of technology is used for tunneling in Bhutan?   (1 mark)

   d. What two methods are usually used for estimating design floods?   (2 marks)

   e. What are some common modes of failure for Gravity Dam?   (2 marks)

   f. What is the major cause of cracks in mass concrete gravity dams? Name 4 measures
       employed to minimize such cracks.   (4 marks)

   g. What are the most suitable foundation conditions for concrete gravity dams? What kind
       of geological investigations are performed for ascertaining the foundation conditions?

                                                                                    (3 marks)

   h. In your report, assume that you are proposing a concrete gravity dam as illustrated below
       for construction.

(Please see page 9 for the illustration)
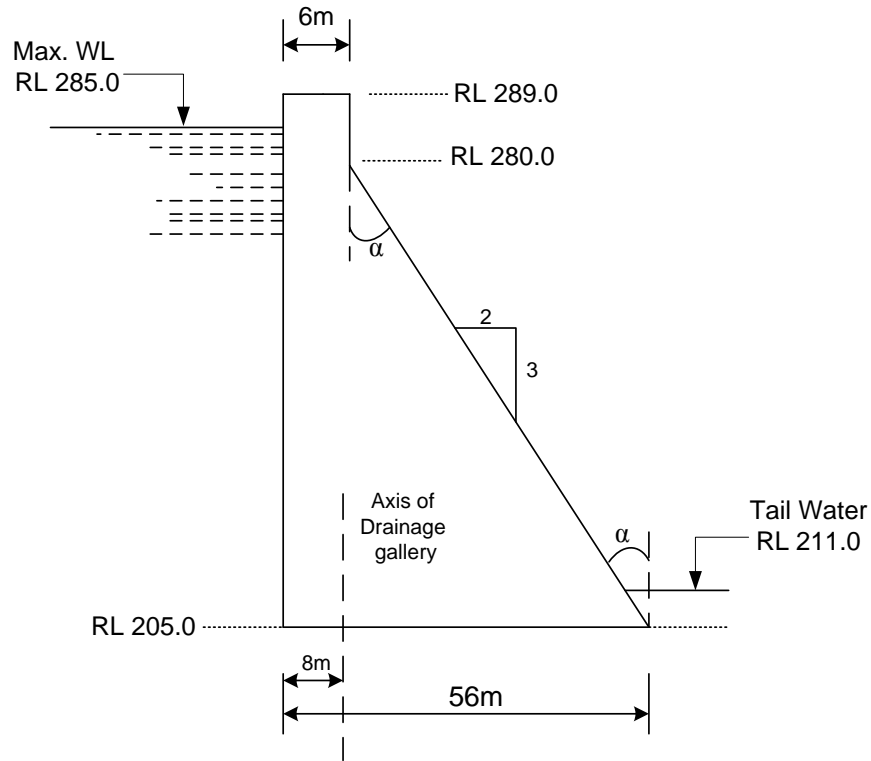
The figure above shows the section of concrete gravity dam (non-overflow portion)

With reference to the above figure, answer the following questions. (**Neglect earthquake effects, Assume** $\gamma_w = 9.81$ **kN/m^3**)

i. Draw the various forces acting on the Dam (10 marks)

ii. Calculate Maximum vertical stresses at the heel and the toe of the Dam respectively (10 marks)

iii. The Major Principal stress at the toe of the Dam *(note: $sec^2\ \alpha = 1+tan^2\ \alpha$)* (8 marks)

iv. The intensity of shear stress on a horizontal plane near the toe (5 marks)

CASE 2

As a part of your building design works, design a combined footing connecting columns A and B, 4 m centre to centre, carrying an ultimate axial load of 1000 kN and 1400 kN respectively. The boundary line of the property is 400 mm from the outer face of the column A. Column A is 360 mm x 360 mm and column B is 420 mm x 420 mm. The bearing capacity of the soil obtained from plate load test is 106 kN/m^2. Use M20 mix and Fe 415 grade steel. Assume effective cover equal to 60 mm.

    a. Find the minimum depth of footing and state why it is required?   (3 marks)

    b. Determine an appropriate size of footing pad using above data and show in sketch.

          (5 marks)

    c. Draw a bending moment diagram and shear force diagram.   (20 marks)

    d. Find reinforcement required and show the detail drawings.   (20 marks)

    e. When do we design combine footing?   (2 marks)