

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-VIII EXAMINATION – WINTER 2015

Subject Code: 180601**Date: 09/12/2015****Subject Name: Design of Hydraulic Structures****Time: 2:30pm to 5:00pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1 (a)** What are the basic data required for planning of dams and reservoirs? Discuss different levels in the investigation for a reservoir project. **07**
- (b)** (i) Discuss different criteria for the design of an earth dam. **03**
(ii) Distinguish between the following: **04**
Rolloled-fill earth dam and Hydraulic-fill earth dam,
Hydraulic failure and Seepage failure of earth dam
- Q.2 (a)** Determine the ordinates of the seepage line through the dam section, as shown in Fig. 1, using Casagrande method. Assume that the outer shell is made of pervious material while the central core section is made of relatively impervious material having coefficient of permeability 2.1×10^{-5} m/sec. Draw the correct nature of the seepage line applying ingress and egress corrections. Take the ratio $\Delta a / (a + \Delta a) = 0.34$. Also, work out the seepage discharge per 100 m length of the dam when reservoir is full. **07**
- (b)** Stability analysis of a homogeneous earth dam (shown in Fig. 2) was carried out using the slip circle method. Following data is available for the dam: **07**
Porosity = 27 %,
Specific gravity of soil = 2.5,
Cohesion $C = 30 \text{ kN/m}^2$,
Angle of internal friction = 30° ,
Width of slice ABCD = 30 m,
Directional angle with center of slip circle = 20° ,
Total area of the slice ABCD = 600 m^2 and area above the phreatic line is 10 % of total area of the slice.
Determine the stability of the portion ABCD (i.e. slice ABCD) of the dam, considering the fact that the material on both the sides of the slice is sliding along the failure plane.
- OR**
- (b)** Discuss the effects of pore water pressure on the stability of an earth dam. Explain with figure, how is the pore water pressure worked out in the stability analysis of an earth dam using slip-circle method? **07**
- Q.3 (a)** Explain, clearly, the functions served by the following in the gravity dam: **08**
(i) Galleries
(ii) Keys
(iii) Joints
(iv) Water stops

- (b) A concrete gravity dam of 104 m height and 4 m free board has upstream face slope at 0.15:1. The horizontal seismic acceleration coefficient α is 0.1g. Determine the hydrodynamic pressure exerted on the dam at 50 m below FRL. Also workout the total hydrodynamic force acting on the dam, location of its line of action and moment due to it. **06**
- OR**
- Q.3** (a) Discuss, in detail, safety criteria for the design of a gravity dam. **06**
 (b) Calculate the normal stresses at the heel and toe of a dam section shown in the Fig. 3, for reservoir empty and full conditions. Consider the self-weight, water pressure and uplift pressure forces only. Also, calculate the factor of safety against overturning and shear friction factor. Take shear strength 3500 N/m^2 , coefficient of friction μ as 0.75 and specific weight of concrete 24 kN/m^3 . **08**
- Q.4** (a) Derive the expression for the limiting height of a low gravity dam. Differentiate between the high dam and low dam. **07**
 Design and sketch the practical profile of a gravity dam for the following data:
 RL of base of dam = 150 m ,
 RL of HFL = 180.5 m,
 Safe compressive strength = 120 t/m^2 ,
 Height of waves = 1.0 m
- (b) Why is the energy dissipating structures needed in the dam? What are the different types of energy dissipating structures constructed with the dam? Explain, with suitable sketches, energy dissipation through roller buckets. **07**
- OR**
- Q.4** (a) “Spillway is a safety valve in the dam”--Discuss. What are different components of the spillway? Enumerate different types of spillway and explain the working of Syphon spillway, with a neat sketch. **07**
 (b) Define the following terms, in view of Ogee spillway: **07**
 (i) Head (ii) Design head
 (iii) Total energy head (iv) High overflow spillway
 Compute the discharge over an Ogee weir at a head of 2.5 m. The length of the weir is 100 m and the weir crest is 8 m above the bottom of the approach channel having the same width as that of the weir. Take constant of discharge $C = 2.4$.
- Q.5** (a) Discuss various considerations in the selection of a type of dam. **06**
 (b) Explain the necessity of canal falls in a canal system? Enumerate different types of canal falls and discuss any one of them in detail. **08**
 For a canal fall, following data were observed:
 FSL = RL210 m
 Canal bed level = RL 207 m,
 Canal bed width = 16 m,
 Discharge = 35 cumecs,
 Crest length of the fall = 10 m,
 Constant of discharge $C = 1.7$
 Calculate the crest level of the fall, assuming the rectangular canal section.
- OR**
- Q.5** (a) Explain, with neat sketch, location of cross regulator and distributary head regulator in a canal network. Also, discuss their functions. Discuss the design criteria for a canal cross regulator. **08**
 (b) Sketch the typical section of a zoned earth dam and explain the significance of various zones in the zoned earth dam. **06**

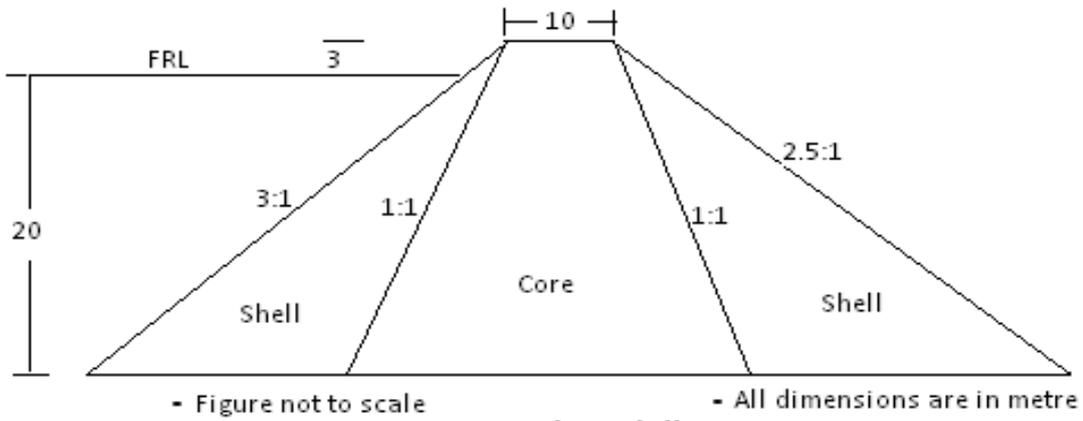


Fig. 1 (Q. 2 (a))

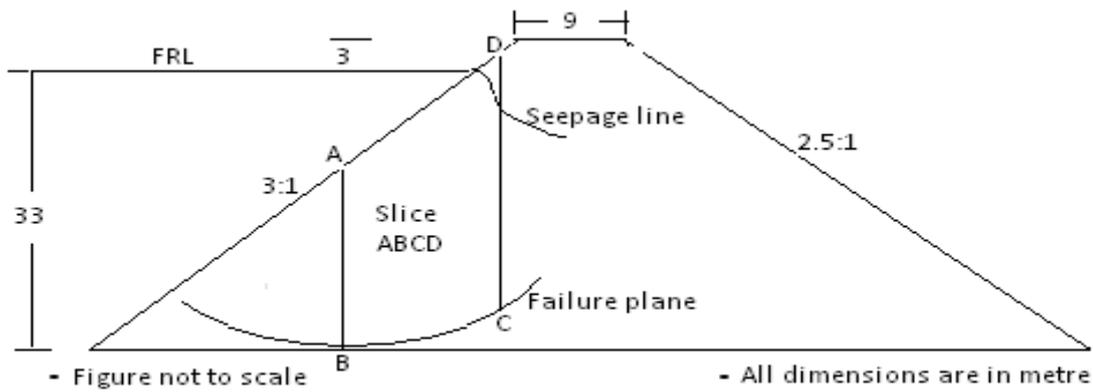


Fig. 2 (Q. 2 (b))

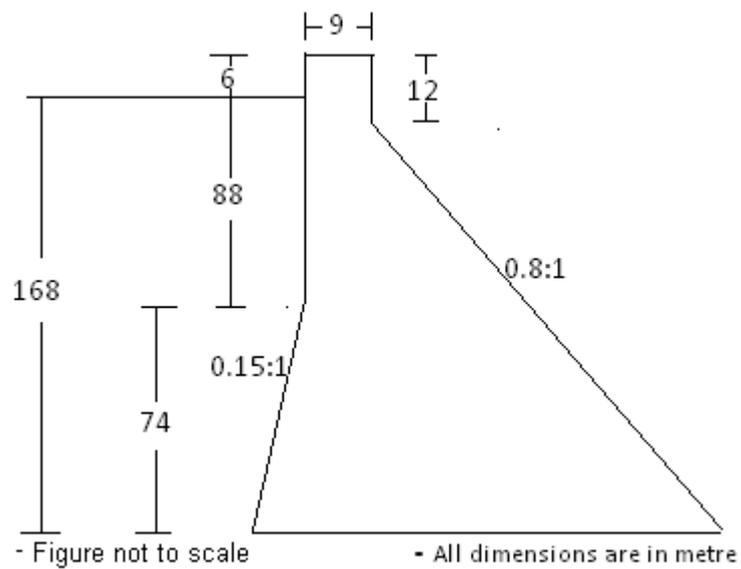


Fig. 3 (Q. 3 (b))
