Total overturning moment about toe: 1×10^5 N-m
Total resisting moment about toe: 2×10^5 N-m
Total vertical force above base: 5000 N
Base width of the dam = 50 m
Slope of the d/s face = 0.8(H) : 1(V)
Calculate the maximum and minimum vertical stress to which the foundation will be subjected to. What is the maximum principal stress at toe? Assume there is no tail water.

(3 + 3) + 6 = 12

9. The cross-section of a gravity dam is shown in Fig.2. Determine the principle stress at heel and toe, the shear stress at heel and toe for the following conditions; factor of safety against overturning; sliding (μ = 0.75); maximum principal stress at toe.

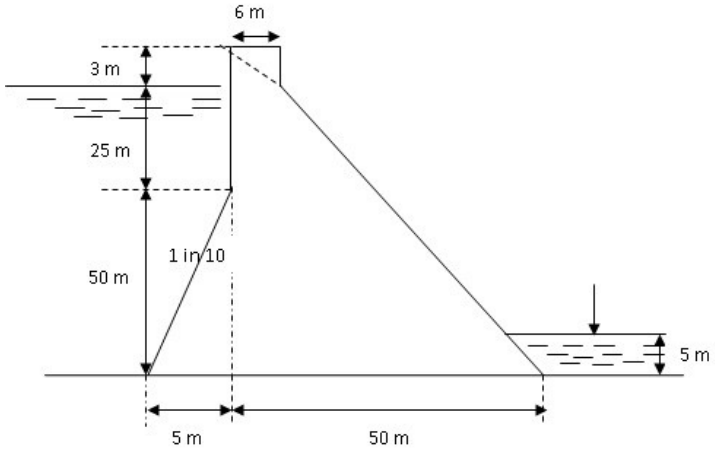

Fig.2

12

HYDRAULICS STRUCTURES
(CIVL 4144)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) The rate of seepage through an earth dam obtained from a flow net is given by (with usual notation)
(a) $q = Kh\,(N_d \times N_f)$ (b) $q = Kh\,(N_d / N_f)$
(c) $q = kh\,\sqrt{(N_f / N_d)}$ (d) $q = kh\,(N_f / N_d)$

(ii) Silt excluders are constructed
(a) on river bed downstream of head regulator
(b) on river bed upstream of the head regulator
(c) on canal bed downstream of canal head regulator
(d) on canal bed upstream of canal head regulator.

(iii) The centre of pressure of wave pressure due to wave height h_w acting on a gravity dam will be at a height of above the maximum sill water level of
(a) $h_w/3$ (b) $3h_w/8$ (c) $h_w/2$ (d) $2h_w/3$.

(iv) Uplift pressure is considered in the analysis of gravity dam
(a) only when there is drainage gallery in the dam
(b) only when there is tail water
(c) only when the reservoir is empty
(d) in all situation with water in the reservoir.

(v) The back water effect of a weir is best called
(a) retrogression (b) afflux (c) back water curve (d) ponding.

(vi) When sand and gravel foundation strata is available at a proposed dam site of moderate height, the dam may be of the type
(a) earthen dam or rockfill dam (b) masonry gravity dam
(c) double arch dam (d) concrete gravity dam.

(vii) Value of Khosla's critical exit gradient for usually met alluvial sandy soils of our country is about
(a) 0 (b) 1 (c) ∞ (d) 1/4 to 1/6.

(viii) The factor that does not try to destabilise a masonry gravity dam is
(a) water seeping below the foundation of the dam
(b) generation of waves by high winds
(c) deposition of silt in dead storage zone of reservoir
(d) water standing against the downstream face of the dam.

(ix) The undersluices in a diversion headwork are provided with a crest level
(a) same as the rest of the weir
(b) lower than the rest of the weir
(c) higher than the rest of the weir
(d) same as the crest of canal regulator.

(x) The dams that are often called as spillways
(a) overflow dams (b) diversion dams
(c) non-overflow dams (d) rigid dams.

Group – B

2. (a) Draw a typical layout of diversion head-works, indicating the various components of the system.

(b) Write in detail about divide wall and river training works.

4 + 8 = 12

3. (a) Differentiate between a weir & a barrage with the help of neat sketches.

(b) Draw and explain various types of diversion weirs.

4 + 8 = 12

Group – C

4. (a) What are the causes of failures of hydraulic structures on permeable foundations and what remedies are suggested to prevent them?

(b) A flownet for seepage flow through soil below a hydraulic structure gives $N_f = 3$; $N_d = 30$ and total head causing the flow = 10 m. What is the quantity of flow per metre run occurring under the structure? Take $k = 10^{-6}$m/s.

9 + 3 = 12

5. The accompanying Fig.1 shows the section of a hydraulic structure on permeable foundation. Calculate the average hydraulic gradient according to Bligh's creep theory and Lane's weighted creep theory. Also find the uplift pressures at point A, B and C as shown in fig. and also the floor thickness required at these points.

Locate the points where both the required floor thickness is same, from both the theories.

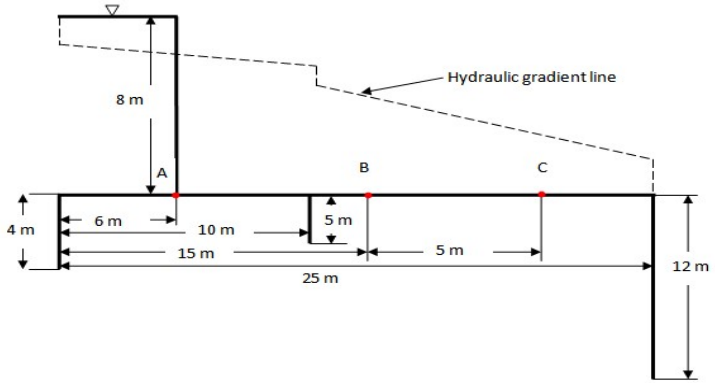

Fig.1

(6 + 6) = 12

Group – D

6. Write short notes on:
(i) Gravity dam
(ii) Embankment dams
(iii) Selection of site for dam construction.

(3 × 4) = 12

7. (a) An earthen dam made of homogenous material has the following data.
Level of top of dam = 220m
Level of deepest riverbed = 192m
HFL of reservoir = 210m
Width of top of dam = 10m
Upstream slope = 4:1
Downstream slope = 2:1
Determine the phreatic line for this dam section and also the discharge through the dam.

(b) If a horizontal filter is provided inward from the downstream toe of the dam equal to 25 m, draw the seepage line.

8 + 4 = 12

Group – E

8. (a) Draw typical cross-section of a concrete gravity dam. Define the elementary profile of a gravity dam.

(b) Following data were obtained from the stability analysis of a concrete gravity dam: