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CHAPTER

Headworks and Seepage Theory

Q.1 While designing a hydraulic structure, the piezometric head the bottom of tha floor is 10 m. The datum is 3 m below floor bottom. The assured standing water depth above the floor is 2 m. The specific gravity of the floor material is 2.5. The floor thickness should be
(a) 2.00 m (b) 3.33 m
(c) 4.43 m (d) 6.00 m

Q.2 Uplift pressures at points *E* and *D* (Figure *A*) of a straight horizontal floor of negligible thickness with a sheet pile at downstream end are 28% and 20%, respectively. If the sheet pile is at upstream end of the floor (Figure *B*), the uplift pressures at points D_1 and C are

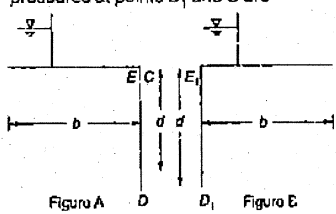


Figure A Figure B

(a) 68% and 60% respectively
(b) 80% and 72% respectively
(c) 88% and 70% respectively
(d) 100% and zero respectively

Q.3 According to Bligh, the top width of weir wall is expressed as
(a) $H/(G-1)^{1/2}$ (b) $H/(G-1)^{2/3}$
(c) $H/(G-1)^{1/4}$ (d) $H/(G-1)^{2/3}$

Q.4 Point out the incorrect statement in relation to the design of weirs and barrages:
(a) Bligh's safe hydraulic gradient is the same as the Khosla's safe exit gradient.
(b) The first streamline below a barrage section follows the bottom profile of the section.
(c) Equipotential lines are the lines joining the points of equal residual seepage head.
(d) None of the above.

Q.5 Safe exit gradient, as enunciated by Khosla's theory of design of weirs and barrages, is
(a) the actual seepage gradient available at the downstream exit point.
(b) the seepage gradient at the downstream exit point, equalling the submerged weight of a unit volume of soil there.
(c) about $\frac{1}{4}$ to $\frac{1}{6}$ times the gradient which is just able to lift the soil grain at the downstream exit point.
(d) None of the above

Q.6 When seepage takes place below a horizontal floor without any sheet piles, the streamlines are
(a) confocal hyperbolas.
(b) confocal parabolas.
(c) confocal ellipses.
(d) straight lines.

Q.7 Which of the following factor is not to be considered in the design of major hydraulic structure founded on an alluvial North Indian River?
(a) Uplift caused by steady seepage.
(b) Piping caused by steady seepage.
(c) Uplift caused by high flood flow in the jump through.
(d) None of the above

Q.8 When seepage flow takes place below a flat floor without any sheet piles, the potential f_x below the floor at 1/4 floor length from the upstream end is
(a) 66.67% (b) 33.33%
(c) 75% (d) 100%

Q.9 Point out the correct meaning of 'piping', as applied to the design of barrages.
(a) It refers to a network of pipes laid below the hydraulic structure to remove the seeping water.
(b) It refers to the process of undermining of foundation and creation of hollows therein.
(c) It refers to the uplift force caused by seeping water on the floor of the hydraulic structure.
(d) None of the above

Q.10 Just downstream of the pucca concrete floor of a barrage section, an inverted filter covered by cement concrete blocks is laid in a length of about 1.5 D to 2D, where D is
(a) the Lacey's normal scour depth.
(b) 1.5 times the Lacey's normal scour depth.
(c) 1.5 times the Lacey's scour depth minus the downstream water depth.
(d) None of the above.

Q.11 The Khosla's formula for the correction C, to be applied to the seepage potential below a weir floor, to account for the mutual interference of a pile of depth D on an adjacent pile of depth d, separated by a distance b_1 in a total floor length of b is
(a) $C = 19\ [(D/b_1)\ (D + d)/b]^{1/2}$
(b) $C = 19\ (D/b_1)\ [(D + d)/b]^{1/2}$
(c) $C = 19\ [(D + d)/b]\ (D/b_1)^{1/2}$
(d) $C = 19\ [(D/b_1)\ b/(D + d)]^{1/2}$

Q.12 King's vanes are
(a) surface vanes to prevent the entry of suspended sediment from entering into the offtake.
(b) a form of tunnel-type silt excluder provided in front of a regulator.
(c) submerged vanes provided at the head of an offtaking canal to control the entry of bed material load into the offtake.
(d) floating vanes used to divert the floating debris from entering into the offtake.

Q.13 The escape discharge in a sediment ejector will generally be about
(a) 10 - 20% of the full supply discharge of the canal downstream of the ejector
(b) 10 - 20% of the full supply discharge in the canal upstream of the ejector
(c) 4 - 8% of the full supply discharge up stream of the ejector
(d) 30% of the minimum discharge in the canal downstream of the ejector.

Q.14 A skimming platform for sediment control in an offtaking canal
(a) allows a proportionate share of the sediment in the parent channel to enter into the offtake.
(b) allows only the relatively low sediment concentration layers to enter into the offtake.
(c) allows the relatively high sediment charged bottom layers to enter into the offtake.
(d) allows sediment in excess of proportional share to enter into the offtake.

Q.15 The silt vanes used for sediment control in offtaking canals have a height
(a) equal to 50 to 60% of the width of the channel.
(b) of 1/4 the depth of flow in the offtake channel.
(c) which is at least 30 cm larger than the full supply depth of the parent channel.
(d) of 1/4 to 1/3 the depth of flow in the parent channel.

Q.16 Bulkhead gates are
(a) installed at the entrance and used for unwatering the conduit for inspection and maintenance.
(b) regulation gates to throttle or vary the rate of flow.
(c) a type of high head gates which can work under widely varying heads efficiently
(d) large size gates used in the middle of an outlet conduit for shutting off the flow in case the primary closure device becomes inoperative.

Q.17 Silt ejectors are provided as silt controlling devices on
(a) upstream of a canal head regulator.
(b) downstream of a canal head regulator.
(c) upstream of a spillway.
(d) downstream of a spillway.

Q.18 A canal headwork in rocky stage of a river is not suitable because
(a) a costly head regulator is required.
(b) more falls are necessary to dissipate the energy.
(c) more cross drainage works are required.
(d) All of the above.

Q.19 The Lacey's scour depth equation, $R = 1.35\left(\frac{q^2}{f}\right)^{1/3}$ is applicable when the river width equals
(a) actual river width.
(b) regime width.
(c) only contracted width.
(d) All of the above.

Q.20 For the construction of canal headworks, the suitable stages of river are:
1. Torrential state
2. Boulder stage
3. Alluvial stage
4. Delta stage
(a) 1 and 2 (b) 3 and 4
(c) 2 and 3 (d) 1, 2, 3 and 4

Q.21 Anadromous fish often move large distances in rivers in India
(a) to upstream only.
(b) to downstream only.
(c) to downstream in winter and upstream in summer.
(d) to upstream in winter and downstream in summer.

Q.22 The functions of a divide wall are:
1. To separate the higher crest 'undersluice side' from the lower crest 'weir side'.
2. To resist the overturning effect on the weir.
3. To control eddy current or cross current in front of channel head.
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

Answers Headworks and Seepage Theory

1. (c)	2. (b)	3. (e)	4. (a)	5. (c)	6. (c)	7. (d)	8. (a)	9. (b)	10. (c)
11. (c)	12. (c)	13. (a)	14. (b)	15. (d)	16. (a)	17. (b)	18. (d)	19. (b)	20. (c)
21. (c)	22. (b)								

Explanations Headworks and Seepage Theory

1. (c)
Thickness of floor

$$= \frac{1.33\,h}{G-1}$$

$$= \frac{1.33 \times (10-2-3)}{2.5-1}$$

$$= 4.43 \text{ m}$$

2. (b)
Pressure at $D_1 = 100 - D = 80\%$ and as pressure decrease by 8% from E to D, it also decrease by 8% from D_1 to E_1.

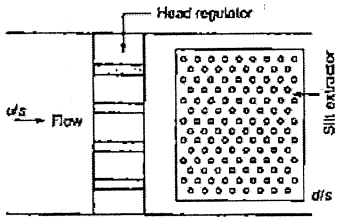
3. (a)

Top width of weir wall is given by $\frac{H}{\sqrt{G-1}}$.

where H = Head of water over the weir wall at the time of maximum flood.

13. (a)
Escape discharge in a sediment ejector is about 10-20% of full supply discharge of the canal down stream of the ejector.

17. (b)
Silt ejectors are those devices which extract the silt from the canal water after the silted water has travelled a certain distance in the off take canal. These works are therefore constructed on the bed of the canal and little distance *d/s* from head regulator.



Hence option (b) is correct.

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