

- 1) A road is provided with a horizontal circular curve having deflection angle of  $55^\circ$  and centre line radius of  $250m$ . A transition curve is to be provided at each end of the circular curve of such a length that the rate of gain of radial acceleration is  $0.3m/s^3$  at a speed of  $50km$  per hour. Length of the transition curve required at each of the ends is
  - a)  $2.57m$
  - b)  $33.33m$
  - c)  $35.73m$
  - d)  $1666.67m$
- 2) A light house of  $120m$  height is just visible above the horizon from a ship. The correct distance ( $m$ ) between the ship and the light house considering combined correction for curvature and refraction, is
  - a)  $39.098$
  - b)  $42.226$
  - c)  $39098$
  - d)  $42226$

## COMMON DATA QUESTIONS

*Common Data for Questions 3, 4 and 5:*

A rectangular channel  $6.0m$  wide carries a discharge of  $16.0m^3/s$  under uniform flow condition with normal depth  $1.60m$ . Manning's  $n$  is  $0.015$ .

- 3) The longitudinal slope of the channel is
  - a)  $0.000585$
  - b)  $0.000485$
  - c)  $0.000385$
  - d)  $0.000285$
- 4) A hump is to be provided on the channel bed. The maximum height of the hump without affecting the upstream flow condition is
  - a)  $0.50m$
  - b)  $0.40m$
  - c)  $0.30m$
  - d)  $0.20m$
- 5) The channel width is to be contracted. The minimum width to which the channel can be contracted without affecting the upstream flow condition is
  - a)  $3.0m$
  - b)  $3.8m$
  - c)  $4.1m$

d) 4.5m

*Common data for Questions 6 and 7:*

A reinforced concrete beam of rectangular cross section of breadth 230mm and effective depth 400mm is subjected to a maximum factored shear force of 120kN. The grades of concrete, main steel and stirrup steel are M20, Fe415 and Fe250 respectively. For the area of main steel provided, the design shear strength  $\tau_c$  as per IS:456 – 200 is  $0.48\text{N/mm}^2$ . The beam is designed for collapse limit state.

- 6) The spacing (mm) of 2-legged 8mm stirrups to be provided is
- 40
  - 115
  - 250
  - 400
- 7) In addition, the beam is subjected to a torque whose factored value is 10.90 kNm. The stirrups have to be provided to carry a shear (kN) equal to
- 50.42
  - 130.56
  - 151.67
  - 200.23

LINKED ANSWER QUESTIONS: Q.8 TO Q.17 CARRY TWO MARKS EACH.

*Statement for Linked Answer Questions 8 and 9:*

Beam *GHI* is supported by three pontoons as shown in the figure 7.1. The horizontal cross-sectional area of each pontoon is  $8\text{m}^2$ , the flexural rigidity of the beam is  $10000\text{ kN-m}^2$  and the unit weight of water is  $10\text{ kN/m}^3$ .

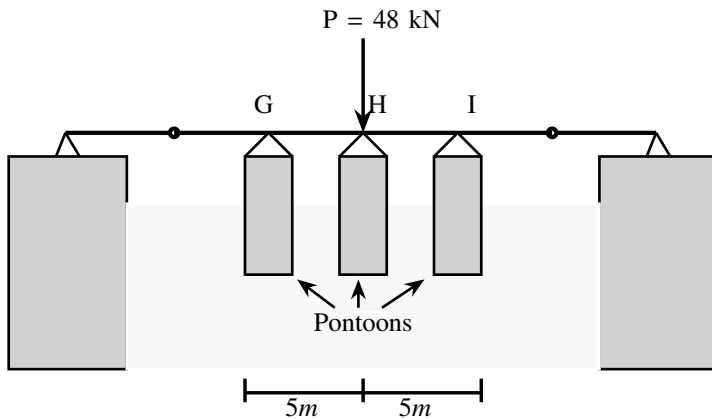


Fig. 7.1

- 8) When the middle pontoon is removed, the deflection at *H* will be

- a)  $0.2m$
  - b)  $0.4m$
  - c)  $0.6m$
  - d)  $0.8m$
- 9) When the middle pontoon is brought back to its position as shown in the figure 7.1, the reaction at  $H$  will be
- a)  $8.6 \text{ kN}$
  - b)  $15.7 \text{ kN}$
  - c)  $19.2 \text{ kN}$
  - d)  $24.2 \text{ kN}$

*Statement for Linked Answer Questions 10 and 11:*

The ground conditions at a site are shown in the figure 9.1

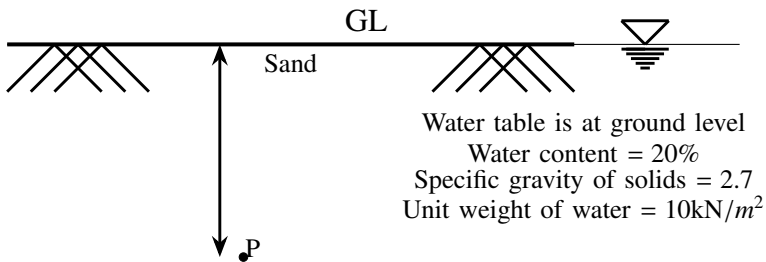


Fig. 9.1

- 10) The saturated unit weight of the sand ( $\text{kN/m}^3$ )
- a) 15
  - b) 18
  - c) 21
  - d) 24
- 11) The total stress, pore water pressure and effective stress ( $\text{kN/m}^2$ ) at the point  $P$  are, respectively
- a) 75, 50 and 25
  - b) 90, 50 and 40
  - c) 105, 50 and 55
  - d) 120, 50 and 70

*Statement for Linked Answer Questions 12 and 13:*

A column is supported on a footing as shown in the figure 11.1. The water is at a depth of  $10m$  below the base of the footing.

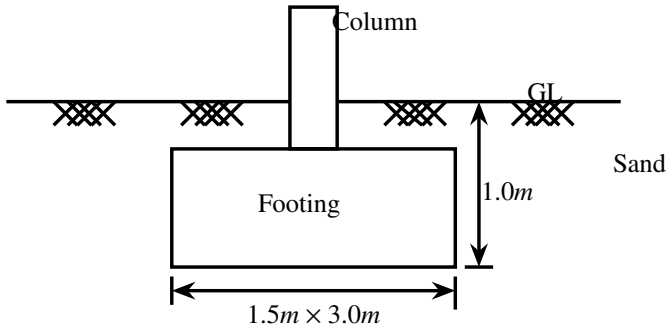


Fig. 11.1

- 12) The net ultimate bearing capacity ( $\text{kN}/\text{m}^2$ ) of the footing based on Terzaghi's bearing capacity equation is
- 216
  - 432
  - 630
  - 846
- 13) The safe load (kN) that the footing can carry with a factor of safety 3 is
- 282
  - 648
  - 945
  - 1269

*Statement for Linked Answer Questions 14 and 15:*

An automobile with projected area  $26\text{m}^2$  is running on a road with a speed of 120 km per hour. The mass density and the kinematic viscosity of air are  $1.2\text{kg}/\text{m}^3$  and  $1.5 \times 10^{-5}\text{m}^2/\text{s}$ , respectively. The drag coefficient is 0.30.

- 14) The drag force on the automobile is
- 620N
  - 600N
  - 580N
  - 520N
- 15) The metric horse power required to overcome the drag force is
- 33.23
  - 31.23
  - 23.23
  - 20.23

*Statement for Linked Answer Questions 16 and 17:*

A horizontal circular curve with a centre line radius of 200m is provided on a 2-lane, 2-way SH section. The width of the 2-lane road is 7.0m. Design speed for this section

is 80 km per hour. The brake reaction times is 2.4s, and the coefficients of friction in longitudinal and lateral directions are 0.355 and 0.15, respectively.

- 16) The safe stopping sight distance on the section is
- a) 221m
  - b) 195m
  - c) 125m
  - d) 65m
- 17) The set-back distance from the centre line of the inner lane is
- a) 7.93m
  - b) 8.10m
  - c) 9.60m
  - d) 9.77m