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BT-4 / M–14

DESIGN OF STEEL STRUCTURES–I

Paper–CE–204 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt **five** questions selecting atleast **one** question from each unit. Use of IS-800 and Steel Tables is allowed. Assume any missing data appropriately and mention the same clearly.*

Unit–I

1. (a) What are high strength friction grip bolts ? Explain their advantages and disadvantages briefly. 8

   (b) Design a bracket connection to support an end reaction of 200 kN. The eccentricity of the load is 250 mm as show in Fig. 1 12

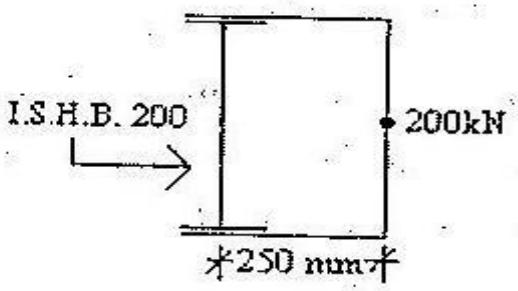

Fig. 1

2. (a) Write short note on splices. 5

   (b) Design a tension member using two angle sections to carry 200 kN when both angles are connected,

   (i) on both sides of the gusset plate, and

   (ii) on the same side on the gusset plate. 15

Unit–II

3. (a) Explain the concept of effective length. 5

   (b) Design a built-up column composed of two channel sections placed back to back carrying an axial load of 1500 kN. Effective length of the column is 5.95 m. Also, design single lacing system for the above column. Take $f_y = 250$ N/mm^2. 15

4. Design a gusseted base for a column ISHB 450 @ 87.2 kg/m, carrying an axial load of 2000 kN. Take allowable bearing pressure on concrete as 4 N/mm^2. 20

Unit–III

5. (a) Explain briefly the concept of web crippling. 5

   (b) A beam consisting of ISMB 600 @ 122.6 kg/m, is simply supported over a span of 8 m. Determine the safe load the beam can carry, assuming that the beam is laterally supported. Take $f_y = 250$ N/mm^2 and $E = 2 \times 10^5$ N/mm^2. 15

6. Design a suitable section for a beam girder carrying U.D.L. of 60 kN/m (inclusive of self-weight) over an effective span of 15.6 m. Take $f_y = 250$ N/mm^2 and $E = 2 \times 10^5$ N/mm^2. 20

Unit–IV

7. Design a gantry girder to carry an overhead travelling crane, having the following data:

   Span of gantry girder = 6 m

   Crane capacity = 200 kN

   Distance between centres of gantry girder = 16 m

Weight of crane girder = 120 kN

Weight of crab = 50 kN

Minimum approach of crane hook = 1.02 m

Distance between centres of wheels = 3.8 m

Height of rail section = 80 mm

Mass of rail section = 30 kg/m

Take $f_y = 250$ N/mm^2 and $E = 2 \times 10^5$ N/mm^2. 20

8. (a) Write briefly on curtailment of flange plates. 5

   (b) A plate girder, simply supported over a span of 15 m carries a total uniformly distributed load of 4000 kN, inclusive of its own weight. The section of the plate girder is shown in Fig. 2. Design the intermediate stiffeners for the plate girder. 15

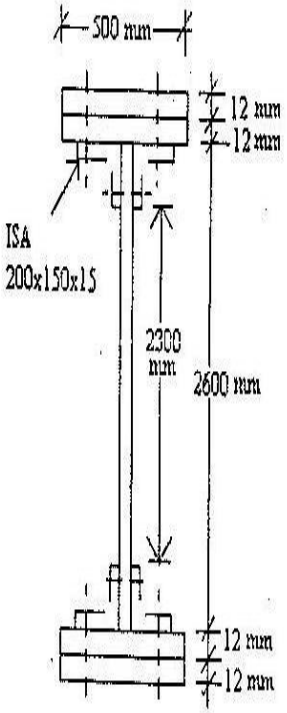

Fig. 2

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FLUID MECHANICS–II

Paper–CE–206 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt **five** questions in all. **First question is compulsory** and attempt **one** question from each unit.*

1. (a) Indicate the most appropriate statement/statements from the following :

(i) A flow is said to be laminar when

(a) the fluid particles move in a zigzag way

(b) the Reynolds number is high

(c) the fluid particles move in layers parallel to the boundary.

(d) the fluid particles do not move at all.

(ii) For pipes arranged in series

(a) the head loss must be same in all the pipes

(b) the velocity must be same in all the pipes

(c) the total flow must be same flowing through each pipe

(d) the total flow equals the sum of the flow rates through each pipe.

(iii) Drag is defined as the force exerted by the flowing fluid on a solid body

(a) in the direction of flow

(b) perpendicular to the direction of flow

(c) at an angle of 45 to the direction of flow

(d) in any direction.

(iv) The depth of flow at which specific energy is minimum is called

(a) normal depth

(b) critical depth

(c) alternate depth

(d) conjugate depth. 4

(b) Fill in the blanks with appropriate word/words :

(i) The ratio of average velocity to maximum velocity for steady laminar flow in circular pipes is .....

(ii) Separation of boundary layer occurs when dp/dx becomes .....

(iii) When a falling body has attained terminal fall velocity, the weight of the body is equal to .....

(iv) The specific speed of a turbine has the dimensions of 6

(c) Write 'T' for true or 'F' for false statement from the following statements :

(i) Turbulence in flow implies the random component of velocity superimposed on mean flow.

(ii) The direction of lift force on an immersed body is tangential to the direction of motion of the body.

(iii) The specific energy in an open channel is the sum of datum head and the depth of flow.

(iv) A normal shock occurs when an abrupt change takes place supersonic to subsonic flow. 4

(d) Write short answers for the following :

(i) Stoke's law

(ii) Equivalent pipe

(iii) Elastic wave. 6

Unit–I

2. (a) Derive a relationship for mean velocity of flow of a viscous fluid through a circular pipe. Also show that the loss of pressure head in any given length of the pipe varies linearly with the mean velocity. 10

(b) The radial clear distance between a hydraulic plunger and the cylinder walls is 0.05 mm, the length and diameter of plunger being 20 cm and 10 cm. respectively. Calculate the velocity of leakage when the difference of pressure between the two ends of plunger is 10 m of water. Take viscosity as 0.0125 poise. 10

3. (a) Distinguish the total energy line and the hydraulic gradient line. 8

(b) Calculate the difference in water surface elevations of the two tanks connected by a horizontal pipe of diameter 25 cm and length 500 m. The rate of flow of water through the pipe is 250 l/s. Assume friction factor f to be 0.033. Consider relevant losses. 12

Unit–II

4. (a) Distinguish a stream-lined body and a bluff body.

(b) A man descends to the ground from an aeroplane with the help of a parachute which is hemispherical in shape and has a diameter of 3 m against the resistance of air with a uniform velocity of 25 m/s. Calculate the weight of the man if the weight of parachute is 9.81 N. Take C_D as 0.5 and the density of air as 1.25 kg/m. 12

5. (a) Show that the critical depth is two-third the specific energy in a channel of rectangular section. 8

(b) Calculate the slope of water surface in a rectangular channel of width 20 m and depth of flow 6 m that carries a discharge of 50 m^3/s. Take bed slope of the channel as 1 in 5000 and Chezy's coefficient as 60. 12

Unit–III

6. A gas is flowing through a horizontal pipe at a temperature of 4.0°C. The diameter of the pipe is 8 cm at a section and the pressure there is 30 N/cm^2 (gauge). The diameter of the pipe suddenly changes from 8 cm to 4 cm and the pressure at the section downstream is 20 N/cm^2 (gauge). Calculate the velocities of the gas at these sections assuming an isothermal process. The value of R may be assumed as 287.14 Nm/kg°K and the atmospheric pressure as 10 N/cm^2. 20

7. Derive an expression for the velocity of sound wave in a compressible fluid when the process is assumed to be adiabatic. 20

Unit–IV

8. (a) Prove that the area of indicator diagram is proportional to the work done by the reciprocating pump. 10

(b) A centrifugal pump delivers water against a head of 15 m and design speed of 1000 rpm. The vanes are curved back to an angle of 30° with the periphery. The impeller diameter is 300 mm and the outer width is 50 mm. Calculate the discharge of the pump if manometric efficiency is 90%. 10

9. A reaction turbine works at 500 r.p.m. under a head of 125 m. Its diameter at inlet is 120 cm and the flow area is 0.5 m^2. The angles made by absolute relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Calculate the volume flow rate, the power developed and the hydraulic efficiency assuming whirl at outlet to be zero. 20

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SOIL MECHANICS

Paper–CE–208 E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *Attempt **five** questions in all, selecting atleast **one** from each unit.*

Unit–I

1. (a) What do you understand by residual soils and transported soils ? 8

   (b) Draw the plasticity chart incorporated in IS : 1498 (1970) and give the group symbols of the various regions in the chart. 12

2. (a) How is permeability of soils determined in the field ? 12

   (b) A horizontal stratified soil deposit consists of three layers, each uniform in itself. The permeabilities of the layers are 4×10^{-4}, 25×10^{-4} and 7.5×10^{-4} mm/s; their thicknesses are 6, 3 and 12 m, respectively. Find the effective average permeability of the deposits in the horizontal and vertical directions. 8

Unit–II

3. The following data refers to a compaction test as per Indian Standard using light compaction : 20

Water content (%)	8.5	12.2	13.75	15.50	18.2	20.2
Weight of wet sample (kg)	1.80	1.94	2.00	2.05	2.03	1.98

If the specific gravity of soil grains was 2.7,

(i) Plot the compaction curve and obtain maximum dry unit weight and optimum moisture content,

(ii) Plot the 80 per cent and 100 percent saturation lines.

4. (a) What is quick sand ? How would you calculate the hydraulic gradient required to create quick sand conditions in a sample of sand ? 10

(b) Explain the mechanics of piping in hydraulic structures. What methods are used to increase the factor of safety against piping ? 10

Unit–III

5. (a) Discuss the essential differences between Boussinesq's and Westergaard's theories. For which condition do both these theories yield approximately the same value of vertical stress ? 12

(b) How far is it justifiable to adopt Boussinesq's theory for predicting the vertical stress in sand deposits ? 8

6. (a) Differentiate between primary consolidation and secondary consolidation. 8

(b) Discuss Terzaghi's theory of consolidation, stating the various assumptions and their validity. 12

Unit–IV

7. What do you understand by :

(i) UU test

(ii) CU test

(iii) CD test

(iv) UC test 20

Explain with the help of neat sketches.

8. (a) How do tension cracks influence the distribution of active earth pressure in pure cohesive soils ? 8

(b) Discuss Culmann's graphical method to estimate active earth pressure on in inclined wall with positive surcharge. 12

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SURVEYING–II

Paper–CE–210 E

Time allowed : 3 hours] *[Maximum marks : 100*

Instructions :

*(i) There are **eight** questions in this paper. All questions carry equal marks.*

*(ii) Attempt **five** questions in all selecting at least **one** from each unit.*

Unit–I

1. (a) Derive a relationship for axis signal correction in geodetic trigonometric leveling. 10

   (b) Following reciprocal observation were made from two points P and Q. PQ = 6996 m, Angle of elevation of Q at P = 1^0 56' 10", Angle of depression of P at Q = $1^0$56'52". Height of Instrument at P and Q = 1.42 m. Height of signal at P and Q = 4.07 m. Find the difference in level between P and Q and the refraction correction. Rsin 1" = 30.88 m. 10

2. (a) From an eccentric station S, 12.25 m to the west of main station B, following angles were measured, BSC = 76^0 25'32", CSA = 54^0 32'20" The station S and C are on the opposite side of the line AB. Calculate correct angle ABC, Lengths AB = 5286.5 m, BC = 4932.2 m respectively. 10

(b) What is meant by eccentricity of signal ? How would you correct the observation when made upon an eccentric signal ? 10

Unit–II

3. (a) Three angles A, B and C are observed at a station D closing the horizon, along with their probable errors is provided below. Determine their corrected values.

$A = 78^0\ 12'12'' \pm 2''$, $B = 136^0\ 48'\ 30'' \pm 4''$ and

$C = 144^0\ 59'\ 08'' \pm 5''$ 10

(b) What is normal equation ? Discuss with an example how to derive normal equation of an unknown. 10

4. (a) Explain in detail about laws of random errors. Provide suitable diagram, if necessary. 10

(b) Adjust the following angles closing the horizon :

$A = 110^0\ 20'\ 48''$ weight = 4 ; $B = 92^0\ 30'\ 12''$ weight = 1 ;

$C = 56^0\ 12'\ 00''$ weight = 2, $D = 100^0\ 57'\ 04''$ weight = 3.

10

Unit–III

5. (a) Determine hour angle and declination of a star from the following data :

Altitude of a star = $21^0\ 30'$; Azimuth of the star = 140^0 E and latitude of observer = 48^0 N 10

(b) Write a detailed note on various coordinate systems used in astronomy. 10

6. (a) Derive suitable relations to calculate hour angle, latitude and azimuth when star is at elongation using Napier's rule of right angled triangle. 10

(b) Find LMT from the following data : LAT = 15h 12m 40s, ET at GMN = 5m 10.65s, additive to apparent time and increasing at 0.22s / hour; longitude of the place = $20^0\ 30'$ W 10

Unit–IV

7. (a) Derive parallax equation for determining elevation and ground coordinate of a point. 10

(b) A section line AB appears 10.16 cm on photograph for which the focal length = 16 cm. The corresponding line measures 2.54 cm on a map which is to a scale of 1/50,000. The terrain has an average elevation of 200 m above msl. Calculate flying height of the aircraft above msl. 10

8. (a) A tower lying on flat area having an average elevation of 800 m above msl was photographed with a camera of focal length = 24 cm. The distance between the image of top and bottom of the tower measures 0.34 cm on photograph. A line AB = 200 m on ground measures 12.2 cm on the same photograph. Determine height of the tower if the distance of the image of the top of the tower is 8.92 cm from principal point. 10

(b) Write a detailed note on aerial camera. Provide a suitable diagram. 10