2015-2016
M.TECH. AUTUMN (III SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
STRUCTURAL ENGINEERING
EARTHQUAKE RESISTANT DESIGN OF STRUCTURES
(CE – 701)

Maximum Marks: 60

Duration: Three Hours

Note: Attempt all questions. All questions carry equal marks. Use of IS:1893-2002 is permitted. Assume data suitably if required. Symbols used have their usual meanings.

1.(a) What is base isolation? How a structure is assessed for suitability of provision of base isolation? (8)
(b) Give the details of types of isolators used and its location in a building? (4)

OR

1'. Considering first two modes only for three degree of freedom system shown in figure 1 below, find (12)
(a) Mode participation factors
(b) Modal displacements
(c) Lateral forces at each floor in each mode
(d) Storey shear forces in each mode
(e) Storey shear due to all modes
(f) Base shear
Consider rock site, damping ratio is 5% of critical damping, \(Z=0.36\) for Zone V, and \(I/R=1.0\).

2.(a) What is a soft storey? Explain the behaviour of soft first storey building. How can the sudden changes in stiffness be avoided? (6)
(b) Explain the behaviour of URM infill panel when subjected to in-plane seismic forces. How a framed building with masonry infills is modeled? (6)

3. (a) Differentiate between flexible and rigid loading diaphragm with reference to the lateral load distribution in masonry building. (4)
(b) Calculate relative rigidity of a masonry wall supporting an RC-roof, considering wall as (i) solid wall, (ii) having openings in the form of a door of size 2.2m × 1.5m and a window of size 1.5m × 1.5m, located at 1m from each end of the wall. Following data are given:
Height of the wall = 4.0m, Thickness of the wall = 0.230m, Length of the wall = 6m.

OR

Contd.....2.
3'.(a) Briefly discuss the effects of eccentricity between of centre mass and centre of rigidity in a masonry structure. (4)

(b) Design and detail lintel band and roof band for a masonry building. Following data are given: (8)
Plan dimension = $5m \times 6m$
Height of the building = $3.5m$
Thickness of the wall = $0.230m$
Thickness of the roof slab = $0.150m$
Design seismic coefficient = 0.21

Use M20 concrete and Fe415 steel. Assume suitably any other data required.

4.(a) Briefly explain the tests conducted on units and the assemblage to ascertain the strength of brick masonry. (8)

(b) What do you understand by the terms repair, strengthening and retrofitting of the structures? Discuss with the help of examples. (4)

5.0 Write short notes on any three of the following: (4×3=12)

(a) Moment magnitude
(b) Out of plane bending
(c) Liquefaction and its effects on structures
(d) Explain irregularity in strength and stiffness of building
(e) Explain the splint and bandage technique of strengthening of masonry building.

Contd.....3.
Mass matrix

\[
\begin{bmatrix}
120 & 0 & 0 \\
0 & 120 & 0 \\
0 & 0 & 120 \\
\end{bmatrix}
\]

Modal matrix

\[
\begin{bmatrix}
0.0328 & 0.0737 & -0.0591 \\
0.0591 & 0.0328 & 0.0737 \\
0.0737 & -0.0591 & -0.0328 \\
\end{bmatrix}
\]

Stiffness

\[K_1 = K_2 = K_3 = K = 10^5 \text{ kN/m}\]

Natural frequencies

\[\omega_1 = 14.03 \text{ rad/sec}\]
\[\omega_2 = 39.33 \text{ rad/sec}\]
\[\omega_3 = 56.982 \text{ rad/sec}\]
M. TECH. (III SEMESTER) EXAMINATION
(CIVIL ENGINEERING)
HYDRAULIC STRUCTURES
SPILLWAYS AND ENERGY DISSIPATORS
(CE-711)

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.

1(a) Discuss the role of spillway in a dam project. [05]

1(b) Compute the design head over an Ogee spillway having seven span of 10m each to pass safely a discharge of 6000 cumec. Also give the hydraulic design of its upstream profile.

Take:

Pier contraction coefficient \( (k_p) \) 0.01
Spillway coefficient 2.15
Abutment contraction coefficient \( (k_a) \) 0.20

OR

1'(b) Enumerate various types of spillways. Describe the construction and working of Volute siphon spillway with a neat sketch. [10]

2(a) Enumerate various types of spillway gates. Explain the construction and working of a Tainter gate with a neat sketch . [10]

2(b) Calculate the flow rate over an Ogee spillway with a head of 2.1m. The length of spillway is 110m. The crown of spillway is 8.5m above the bottom of approach channel having the same width as that of spillway. Take spillway coefficient as 2.10

OR

2'(b) Discuss the design considerations for the location of main as well as emergency spillways. [05]

Contd.....2.
3(a) Discuss the role of jump height curve and tail water curve in selection of an energy dissipating device with a neat sketch.

3(b) A certain spillway is designed for a discharge intensity of 40 cumec per metre. The height of the spillway crest from the river bed is 70 m. The depth of spillage is 12 m. The maximum tail water level above river bed is 20 m. Fairly good rock is available at a depth of 3 m from the river bed. Design a solid roller bucket.

OR

3'(b) A certain spillway is designed for a discharge intensity of 114 cumec per metre. The height of the spillway crest from the river bed is 110 m. The depth of spillage is 16.5 m. The tail water level is lower than the hydraulic jump depth. A good foundation rock is available at a depth of 2 m from the river bed. Design a Ski-jump bucket energy dissipater.

4(a) A certain spillway is designed for a discharge intensity of 68 cumec per metre. The height of the spillway crest from the river bed is 60 m. The depth of spillage is 10 m. The tail water level is almost matching the hydraulic jump depth curve. A weak foundation is available at the project site. Design a Hydraulic Jump type energy dissipater.

4(b) Explain design steps for Hydraulic Jump type energy dissipaters.

OR

4'(b) What do you mean by PMF ?. Discuss its importance.
FIGURE 1

USBR Stilling basin II
Basin Dimensions for Type II

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USBR Stilling basin III
Basin Dimensions for Type III

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<td>4.3</td>
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Q1 (a) List the following information of a water treatment plant operating in a community:

(i) What physical, chemical and biological tests are run on finished water on a routine basis?
(ii) What are the average values of these results?
(iii) Define coliform organisms and the significance of the test. Why can coliform organisms be used as indicators of drinking water quality?
(iv) Draw a water treatment plant scheme for surface water having trace metals
(v) Draw a water treatment plant scheme for ground water having high dose of TDS.

OR

Q1(a') A city of 60,000 population plans to construct a water treatment plant to produce potable water using a design flow of 200 gpcd. The city uses surface water nearby lake. Design;

(i) Intake structure (assume maximum velocity = 0.07 - 0.09 m/s)
(ii) Coarse screen (assume 12-15 mm square edge bars, 4-5 m long, spacing 10-12 cm c/c)
(iii) Fine screen (assume opening with 10-12 mm, maximum velocity = 0.2-0.25 m/s, efficiency factor 0.56, depth of flow 10-12m)
(iv) Gravity main (assume conduit velocity = 0.7-0.8 m/s)

Q1 (b) Describe how a jar test is performed and describe its importance in plant operation.

Q2 A city of 60,000 population plans to construct a water treatment plant to produce potable water using a design flow of 200 gpcd. The city uses surface water nearby lake. Quantity of backwash water used = 30% of filtered output, Time lost during backwash = 30 minutes

Contd.....2.
Design rate of filtration 4.8-6 m³/h, length to width ratio = 1.25-1.33:1. Under drainage system = central manifold with laterals, size of perforations = 9 mm
Design any five of the following components:
(i) Filter dimensions
(ii) Estimation of filter depth
(iii) Estimation of gravel and size gradation
(iv) Design of under drainage system
(v) Compute the dimensions of wash water trough
(vi) Total depth of filter box

Q3 (a) Draw the hydraulic profile in a 0.5 m wide effluent launder of a circular sedimentation tank handling a flow of 20 MLD at a surface loading of 30 m/d.

Q3 (b) Design a horizontal flow baffled channel flocculator for a treatment plant of 40 MLD capacity. The flocculation basin is to be divided into three sections of equal volume, each section having constant velocity gradient of 50, 30 and 20 s⁻¹ respectively. The total flocculation time is to be 30 minutes. Sketch a plan and elevation of the flocculator.

OR

Q3 (b') Design a three compartment mechanical flocculator to treat a design flow of 25000 m³/d. The design G values are 60, 40 and 20 s⁻¹ in each successive compartment and the total detention time is 40 minutes. The maximum depth of the flocculator is 4 m. Sketch a plan and sections of the flocculator.

Q4 (a) Find out the size of the manifold and laterals in a manifold-lateral flow distribution when the influent flow is 0.36 m³/s. The system is supplying three rectangular sedimentation basins in parallel with 4 evenly placed laterals for each basin. The length of the manifold is 25 m and the allowable flow variation between first and last lateral is only 1%.

Q4 (b) A municipal water supply source has TDS of 2500 mg/L. Design reverse osmosis components, to produce finished water having TDS less than 300 mg/L. The plant capacity is 25000 m³/d and the following information is available:

Recovery factor 75%, Salt rejection 90%, Design pressure 600 psi (4140 kN/m²) and Flux rate 0.82 m³/m²·d. Assume a packing density of 820 m²/m³ and 0.03 m³ volume per module.