

Advanced Structural Design (CE 705)

Answer six questions taking any three from each half

All questions carry equal marks

Two marks are reserved for neatness

Take material grade as M20 for concrete Fe415 for steel, if not mentioned otherwise

Assume data suitably, if not given

Use of IS:456,1893,3370,4995 are permitted

Full marks: 70

Time: 3 hours

FIRST HALF

1. Design the cylindrical wall and the conical hopper of a Silo storing cement of unit weight 14.4KN/m^3 with the following data. Height of the wall is 15m, Depth of the hopper is 2.75m, Diameter (internal) of the bin is 6m, Slope of the hopper is 45° , and Co-efficient of the internal friction of cement is 0.316
2. A two storied two bay (both way) RC framed building of grid size 4.5 m x 3.5 m is subjected to seismic forces. Analyze the long frame for bending moment and shear force using Portal or Cantilever method with the following data. Floor slab thickness=120mm, Column size=300mm x 300mm, Tee beam rib size=300mm wide x 250mm deep, Floor to floor height=3.2m, Fundamental natural period=0.3second, Zone factor=0.24, Importance factor=1, Response reduction factor=3, Average response acceleration coefficient=2.5, Live load= 4kN/m^2 .
3. A post tensioned PSC beam of 35 m span is subjected to a transfer prestress force of 2400 KN at 28 days strength. The profile of the cable is parabolic with maximum eccentricity of 150 mm at the mid span and zero at the support. Determine the loss of prestress and the jacking force required if the jacking is done from both ends of the beam. The beam has a cross section of 550 x 750 mm and is prestressed with 8 cables, each cable consisting of 12 wires of 5 mm diameter. Take, $f_p=1600\text{ MPa}$, $E_s=2.1 \times 10^5\text{ MPa}$, $E_c=3.5 \times 10^4\text{ MPa}$, $\mu=0.3$, $k=1.5 \times 10^{-4}$ per meter. Slip of anchorage at each end is 2.5 mm. One cable is tensioned at a time.
4. An open rectangular water tank of size 6m x 6m and 4m deep rest on firm ground. Design the tank using approximate method of analysis under completely filled up condition.
5. An interior panel of a RC flat slab construction of grid size 6m x 6m is subjected to total design service load of 10 KN/m^2 . The slab is 275mm thick throughout without drop and supported on 400 mm square columns without capital. The flexural reinforcements used are $12\phi @ 100\text{mm c/c}$. Check the adequacy of the design.

SECOND HALF

6. A concrete beam of size 450 wide and 800 deep is prestressed with 3 parabolic cables. The cables are located on the cg-axis along depth at 300, 400 and 500mm from bottom at support section and 100, 200 and 300mm from bottom at mid-span section. The bottom and top cables are tensioned with 250kN force each and the middle cable is tensioned with 300kN force. Determine and draw the stress diagrams at both the sections for
- prestress + self weight of the beam and
 - prestress + self weight of the beam+ 30 kN/m live load.
7. Design the conical and bottom spherical dome of an Intze tank with the following data
- Load on the top perimeter of the conical dome is 60kN/m
 - Unit weight of water is 9800N/m³
 - Top diameter of the conical dome is 14m
 - Height of water stored above the conical dome is 5m
 - Depth of conical dome is 2m
 - Rise of spherical dome is 1.6m
 - Diameter of the spherical dome is 10m
 - All dimensions are internal
8. An office building floor is supported on beams and columns at a grid center of 6.0 x 5.0 m. Design and detail a corner slab panel. Take live load = 4 kN/ m². Given that
- Positive and negative moment coefficients for short span as 0.045 and 0.060 respectively and
 - Positive and negative moment coefficients for long span as 0.035 and 0.047 respectively.
9. Determine the dimensions of a T-shaped RC retaining wall to retain earth embankment of height 4m above the ground level. The top of the earth retained is horizontal. The angle of repose of the earth is 35° and its density is 19kN/m³. The safe bearing capacity of the soil is 80kN/m² and co-efficient of friction between concrete and soil is 0.55. Also check for overturning and sliding.
10. A 500mm wide and 700mm deep RC ring beam of 9m mean diameter is curved in plan. The beam is supported on 8 columns all spaced equally on its mean perimeter. If the total design service load from the supported water tank on the beam is 100 kN/m, design longitudinal reinforcement for the beam. Take, i) Maximum flexural moment (sagging) = $k_1 w r^2 \theta$, ii) Maximum flexural moment (hogging) = $k_2 w r^2 \theta$, iii) Maximum torsional moment = $k_3 w r^2 \theta$. Where the coefficients k_1 , k_2 , and k_3 are 0.033, 0.066 and 0.005 respectively, w is the UDL on the beam, r is the mean radius of the ring and θ is the angle subtended by any two consecutive columns at the center of the ring.