Total No. of printed pages = 6

CE 1318 E 041

Roll No. of candidate

2020

B.Tech. 8th Semester End-Term Examination

EARTHQUAKE ENGINEERING

Full Marks – 50   Time – Two hours

Is 1893 (Part 1) – 2002 is allowed.

Assume any missing data

The figures in the margin indicate full marks
for the questions.

Question No. 1 compulsory :

Solve any three from question 2 to question 9.

1.   Fill in the blanks : (any five)

                                        (5 × 1 = 5)

(i)   Percentage of imposed load to be considered
      upto and including 3 kN/m2 for calculating
      design seismic force is ——————

(ii) Building with dual system consist of
      —————— and ——————

(iii) As per IS: 13920-1993, beams shall not have
      width less than ——————

[Turn over

(iv) ──────────── carry the energy of an earthquake away from the focus.

(v) This type of waves compress and expand the ground like an accordion is

(vi) An earthquake's ──────────── is a measurement of its strength based on seismic waves and movement along faults.

(vii) Magnitude of an earthquake is measured with ────────────

(viii) Write the relation between time period, mass and stiffness.

(ix) Define damping ratio

(x) The condition at which the motion is not oscillatory but it will decay with time is ────────────

2. (a) What are interplate and lntraplate earthquakes? Give one example of each of them.

   (b) Define fault. Explain the types of faults with neat diagrams.

   (c) Explain elastic rebound theory with neat diagram. (4+6+5=15)

3. (a) Define Seismology. Explain the various causes of earthquakes.

   (b) Define Isoseismals. Write down the relationship between magnitude and intensity.

   (c) What is seismic hazard? Explain deterministic seismic hazard analysis. (4+3+8=15)

4. (a) Explain free and forced vibration. Write equation of motion for both the cases.

   (b) The amplitude of a SDF system, M = 10 kg, K = 4000 N/m has been reduced by 50% after 5 cycles. Assuming that the system is viscously damped. Find:

   (i) Damping ratio

   (ii) Damping coefficient

   (iii) Critical damping.

   (c) Define dynamic amplification. Write the equation to calculate magnification factor.
   (4+6+5=15)

5. (a) Explain steady state and transient response. Write the equation for transmissibility ratio.

   (b) An automobile is travelling along a multispan elevated roadway supported every 30 m long term creep has resulted in a 150 mm deflection at the middle of each span. The roadway profile can be approximated as sinusoidal with amplitude of 75 mm and a period of 30 m. The SDF system shown is a simple idealization of an automobile. When fully loaded the weight of the automobile id 20 kN. The stiffness of the automobile suspension system is 90 N/m, and its viscous damping coefficient is such that the damping ratio of the system id 40%. Determine:

   (i) The amplitude u'_0 of vertical motion $u'(t)$ when the automobile is travelling at 60 km/hr.

   (ii) The speed of the vehicle that would produce a resonant condition for u_0'.
   (5+10=15)

6. (a) Explain the equivalent static method of analysis.

(b) Calculate the design lateral force at each floor level for the SMRF building situated in zone IV on medium soil. The elevation and plan of the building is shown in Figure Q.6(b).   (3+12=15)

Beam = 250 × 300 mm

Column = 400 × 450 mm

Thickness of slab = 120 mm

Thickness of infill wall = 200 mm

Live load = 3 kN/m^2
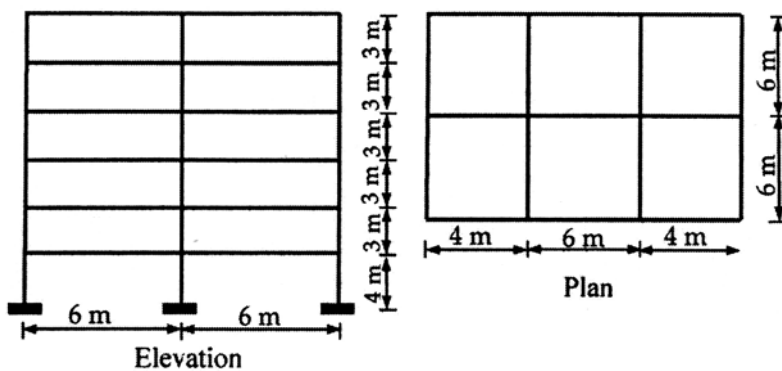
Unit weight of infill wall = 20 kN/m^3

Figure Q.6.(b)

7. (a) Calculate the eigenvalues, eigenvectors and natural time period for the building shown in Figure Q.7.(a)

   (b) Determine the modal participation factor, modal mass, mode shape and lateral force for first floor and for 1st mode of vibration of the same building as in Figure Q.7.(a). Take stiffness, K = 22000 kN/m for all storey.
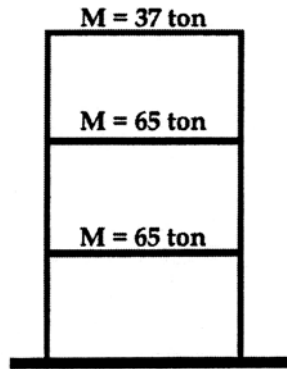
   (9+6=15)

M = 37 ton

M = 65 ton

M = 65 ton

Figure Q.7.(a)

8. (a) What is liquefaction? What are the factors affecting liquefaction of soil?

   (b) A site consists of loose to dense poorly graded sand to silty sand (SP-SM). The SPT values ranges from 9 to 26. The site is located in zone IV. Determine the extent to which liquefaction is expected for 7.5 magnitude earthquake Depth at which liquefaction potential is to be evaluated is 12.75 m where N_{60} value is 17. Take γ_{sat} = 18.5 kN/m^3 and γ_w = 9.8 kN/m^3. Water table is 6 m below the ground level. Consider the fine contents as 8%. Estimate the liquefaction potential and resulting settlement expected at this location.   (4+11=15)

9. (a) Write equations to calculate the shear force capacity of a beam for sway to right.

   (b) Write the general requirement of beam in lateral force resisting system of a structure,

   (c) Draw the details of transverse reinforcement in beam as per IS: 13920-1993. (4+5+6=15)

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