

Question (1) (20 %)

- a- How do water storage tanks at the top of a building affect its fundamental frequency ?
- b- Both systems in fig.(1) has the same m , E , I , Calculate the ratio of their periods (T_1/T_2) when they vibrate freely.
- c- The spring of an automobile trailer shown in figure is compressed under its weight by 100mm. Find the critical speed when the tractor is travelling over a road with a profile approximated by a sine wave of amplitude 75 mm and a wave-length of 16m. What will be the amplitude of vibration at 64 km/h? Neglect damping.

Question (2) (20 %)

- a- Calculate the energy released from an earthquake of Magnitude of 6.0 on Richter scale.
- b- What are the factors that influence the amount of structural damage caused by an earthquake ?
- c- A mass of 1.2×10^6 kg is supported on three vertical columns with lateral stiffness of 10×10^6 N/m for end columns. The columns have no mass and fixed at top ends. The lateral forcing function is shown in figure. . Use Duhamal's integral to calculate the shearing force and moments in the columns after 3 seconds.

Question (3) (20 %)

- a-Define the following terms : earthquake, focal depth, damping, natural frequency, hypocenter, seismograph, tsunami , body waves, response spectrum, drift, seismometer, fault, dynamic system.
- b- Where is the Ring of Fire located? What is the reason for that name ?
- c- A simple one-story building has two shear walls in each direction as shown in figure. It has some gravity columns that are not shown. All four walls have characteristic strength of 25 N/mm^2 , 30 cm thick, and 5.0 m long. The storey height is 4.50 m . The floor consists of cast in-situ reinforced concrete. Design shear force on building is 240 kN in either direction. Compute design lateral forces on all shear walls

Question (4) (20 %)

- a- Write the term that define the following statements:
 - 1-The scale which measure the earthquake intensity.
 - 2-The distance between hypocenter and the epicenter.
 - 3-Earth's outer shell.
 - 4-A train of surface-water waves due to an earthquake.
 - 5-The seismic wave that cause more damage to structures

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- 6-The seismic wave that travel faster.
 - 7-The relation between the maximum response of single degree of freedom due to an earthquake and the period.
 - 8-The scale that measure earthquake strength.
 - 9-The dissipation of energy from an oscillating system.
 - 10-The fraction of the total building mass that acts in any particular mode.

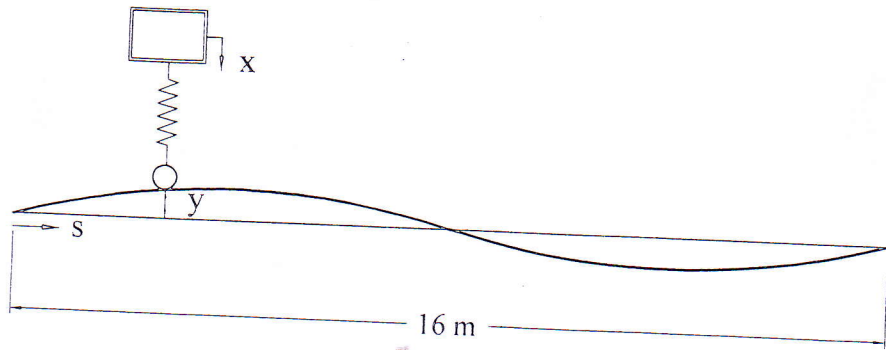
- b- A water tank is supported on a circular shaft as shown in figure. The stiffness of the system is 1000 kN/m and the frequency is estimated to be 2.0 Hz. Calculate the maximum tank displacement and the maximum bending moment in the tank's shaft due to 1940 El Centro Earthquake assuming 10% damping ratio. Calculate the maximum displacements in case of damping ratios 0.0 %, 20.0 %. Use the given Response Spectra.
- c- Irregularities of mass, stiffness, and strength are not desirable in buildings situated in earthquake prone areas. Describe using diagrams how these occur and affect the building.

Question (5) (20 %)

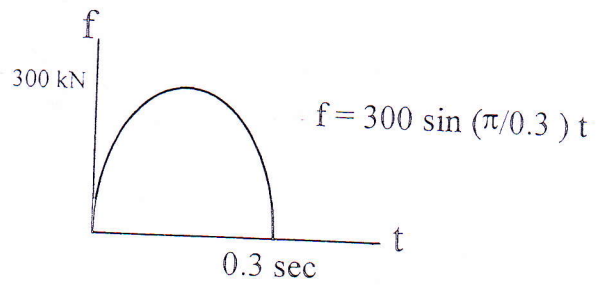
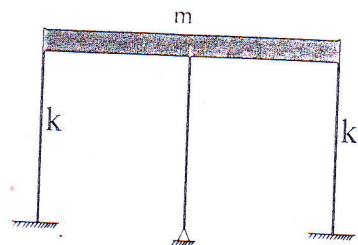
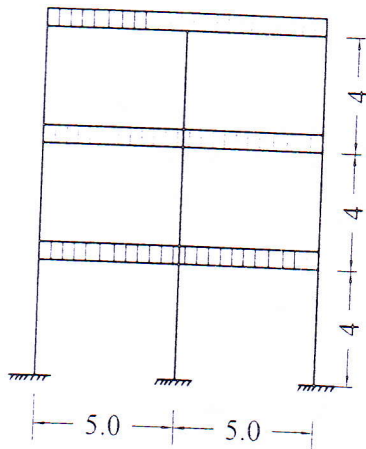
- a- Define liquefaction. What are the factors that affect liquefaction ?
- b- What are the important considerations from the viewpoint of soil to be taken to ensure the safety of structure during an earthquake ?
- c- A soil profile consists of a 5 m-thick surface layer of sand ($\gamma = 16 \text{ kN/m}^3$), Overlying 2 m thick layer of sand ($\gamma = 18 \text{ kN/m}^3$) . The water table is at the ground surface. During an earthquake, water in a driven standpipe rises 2.5 m above the ground surface. Determine the effective dynamic stress at depth of 5.0 m and 7.0 m from the ground surface.

Question (6) (20 %)

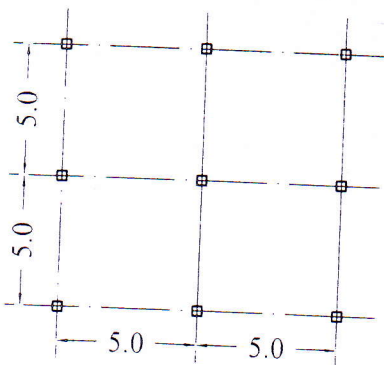
- a- In which case , the earthquake cause twist for the columns of a building ?
 - b- What is the major objective of seismic design cods throughout the world ?
 - c- The plan and elevation of a three-storey reinforced concrete hospital building is shown in figure. The building is located in seismic zone IV. The type of soil encountered is medium and it is proposed to design the building with ductile shear walls. The intensity of dead load is 12 kN/m^2 and the live load is 5 kN/m^2 . Determine the design seismic loads on the structure using equivalent static load method.
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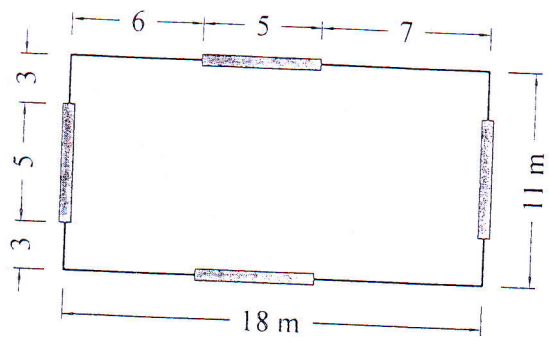
Question 1 - c



Question 2 - a



Question 6 - c



Question 3 - c

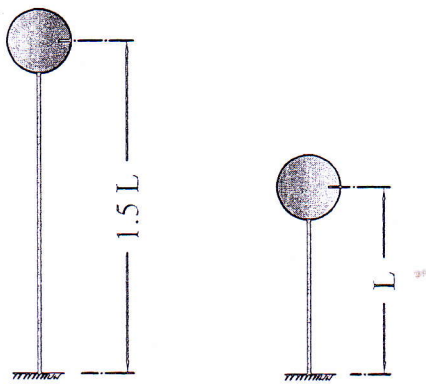


Fig. (1) 1-b

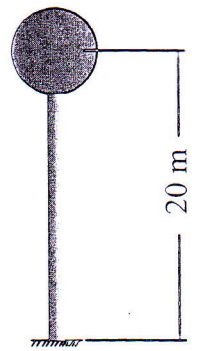
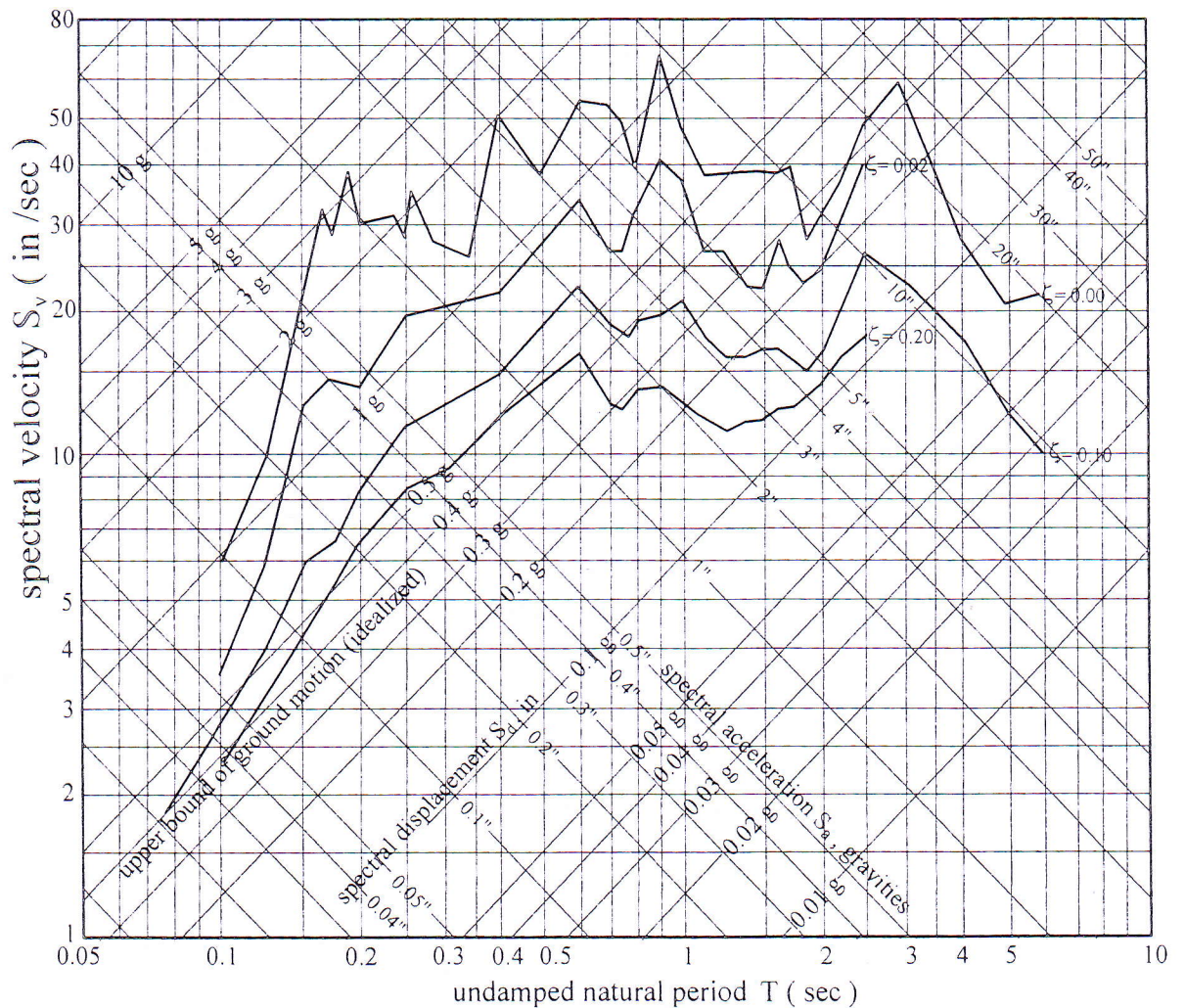


Fig (2) 4-b



(3 - c) Elastic Log Tripartite Plot (1940 Elcentro Earthquake)