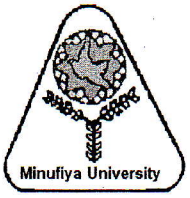
Menoufeya University
College of Engineering
Civil Engineering Dept.



Earthquake Enging
Diploma Jun. 2016
Time Allowed 3 hrs

OPEN BBOK , NOTES, AND HOMEWORK EXAM

Question (1) (20 %)

a- What is meant by the focus and epicenter of an earthquake ? Name the two kinds of body waves and explain how they differ .

b- What are plate tectonic theory and its mechanism ?

c- Write short notes on :
   i- Seismograph.
   ii- Modified Mercalli scale.
   iii- Tsunami.
   iv- Earth's crust.
   v- Earth's mantle.

d- An earthquake causes an average of 3.0 m strike-slip displacement over a 90 km long, 25 km deep portion of a transformed fault. Assuming the average rupture strength along the fault as 0.2 MPa, estimate the seismic moment and moment magnitude of the earthquake.

Question (2) (20 %)

a- What are the various types of dynamic loads? State some of the characteristics of seismic loads.

b- Write the equation of motion and determine the effective stiffness using the basic definition of stiffness for the spring-mass systems shown in figure.

c- An empty elevated water tank is pulled by a steel cable by applying a 40 kN force. The tank is pulled horizontally by 5 cm. The cable is suddenly cut and the resulting free vibration is recorded. At the end of four complete cycles, the time is 3.0 seconds and amplitude is 2.5 cm. Determine the damping ratio, natural period of undamped vibration, effective stiffness, effective weight, and damping coefficient for the given system.

Question (3) (20 %)

a- What are the important considerations from the viewpoint of soil to be taken to ensure the safety of structure during an earthquake ?

b- Define liquefaction. What are the factors that affect liquefaction ?

c- Derive an expression for the condition under which a structure will sink during an earthquake.

d- A soil profile consists of a 5 m-thick surface layer of sand (γ =16 kN/m^3) Overlying 2 m thick layer of sand (γ =18 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 (4) (20 %)

a- Write short notes on:
   i- Strength and stiffness.
   ii- Simplicity and symmetry.
   iii- Stiff and flexible buildings.

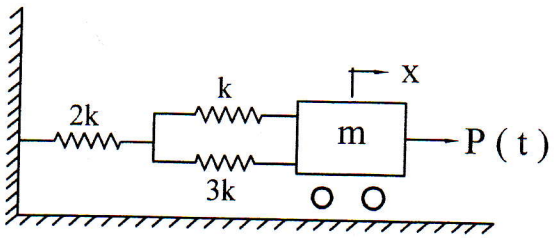
b- Irregularities of mass, stiffness, and strength are not desirable in buildings situated in earthquake prone areas. Describe using diagrams how these occur and affect the building.

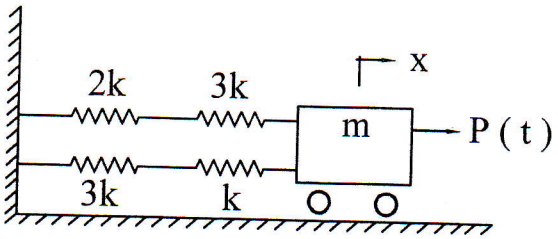
c- The plan of a simple one-storey building is shown in figure. All columns and beams have same cross-sections. Obtain its center of stiffness.

Question (5) (20 %)

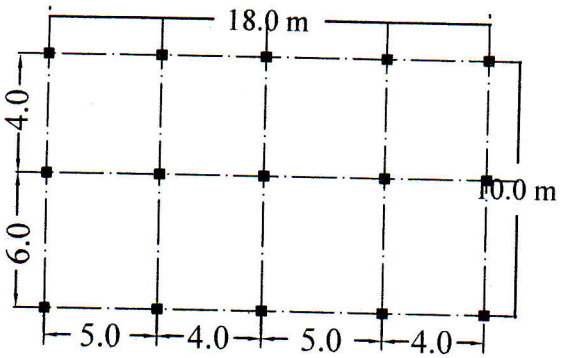
a- The plan and elevation of a three-storey reinforced concrete hospital building is shown in figure. The building is located in seismic zone IV. The type of soil encountered is medium and it is proposed to design the building with ductile shear walls. The intensity of dead load is 12 kN/m^2 and the live load is 5 kN/m^2. Determine the design seismic loads on the structure using equivalent static load method.

b- A simple one-storey 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, 25 cm thick, and 5.0 m long. The storey height is 4.0 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



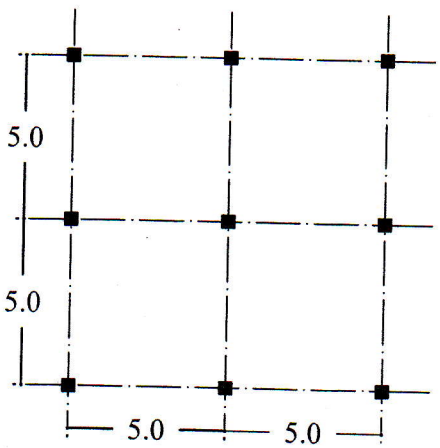


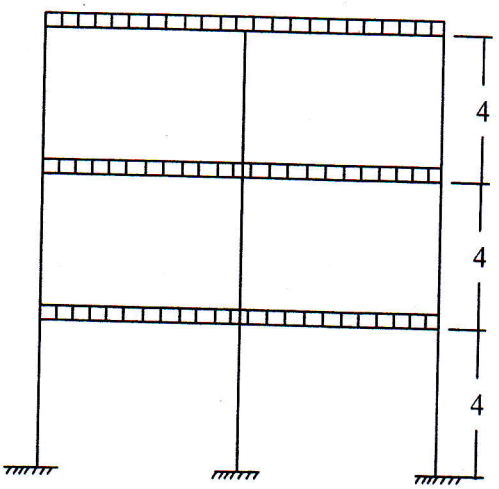
Question 2-b



Question 4-c

Question 5-b





Question 5-a