Seat No.: ________ Enrolment No.______________

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- VIth SEMESTER–EXAMINATION – MAY- 2012

Subject code: 160605 **Date: 19/05/2012**

Subject Name: Earth quake engineering

Time: 10:30 am – 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of IS1893, IS4326 and IS13920 is permitted in the examination hall.**

Q.1 **(a)** Define/Explain the terms mentioned. 1) Epicenter, 2) Intensity, 3) Magnitude, 4) Base shear, 5) Seismograph, 6) Confinement Reinforcement and 7) soft storey. **07**

(b) Discuss in detail the advantage of horizontal bands and vertical reinforcement in the masonry buildings. **07**

Q.2 **(a)** A five storeyed building has size of 30m x 30m. It is located in Bhuj and resting on hard soil. The weights of floors and height of the floors are 2000kN, 2500kN, 2500kN, 2500kN and 2100kN AND 4.5m, 3.5m, 3.5m, 3.5m and 3.5m respectively from slab no.1 from bottom. Assuming the building as special moment resisting office building, calculate the horizontal shear forces acting at the each slab level by equivalent lateral force method. **07**

(b) Discuss in detail the concepts of the ductile detailing in Beams. **07**

OR

(b) Discuss the capacity design concept in ductile detailing. **07**

Q.3 **(a)** A two storey multi storeyed building is idealized as two springs and masses having the values of the same as k_1 = 1kN/m, k_2 = 2kN/m, M_1 = 100kg and M_2 = 50kg respectively from the foundation. Calculate all the natural frequencies and all the normalized mode shapes. **10**

(b) Discuss how the mode shapes are used in the dynamic analysis of the building for calculating earth quake forces. **04**

OR

Q.3 A three storeyed hospital building located in Ahmedabad resting on medium soil is analyzed for free vibration and the the results are as mentioned. W_1 = 1100kN, W_2 = 1300kN and W_3 = 1000kN. ω_1 = 8.3407 rad/sec. ω_2 = 23.2831 rad/sec and ω_3 = 31.5954 rad/sec. The three corresponding mode shapes are {0.2980, 0.5977, 0.7443}, {0.6623, 0.3535,-0.6607} and {0.7031, -0.6237, 0.3415}. Calculate the storey shears by the dynamic analysis. **14**

Q.4 **(a)** Analyze the structure as shown in the figure.1 by portal method and draw the bending moment diagram **07**

(b) A water tank is idealized as a single degree of freedom having equivalent weight of 10000kN, damping ratio as 4% and stiffness factor as 20000kN/m. Calculate (1) the **07**

natural time period, (2) the damped time period, (3) the damping constant and (4) the maximum horizontal displacement at the top of the water tank if it is loaded by a seismic force equivalent to 20*sin(5t) N.

OR

Q.4 **(a)** Analyze the structure as shown in the figure.1 by cantilever method and draw the bending moment diagram **07**

(b) In the laboratory a model of simple support beam is displaced at the middle from the stable condition and allowed to vibrate. It is found that it vibrates with natural time period of 0.1 secs. and the amplitude of the motion was decreased from 4mm to 3.5mm after 5 cycles. The same experiment was repeated by tying 5kg of the weight at the mid span and it was found to vibrate having time period of 1.1 secs. Calculate (1) equivalent mass of the beam, (2) Equivalent stiffness of the beam and (3) the damping ratio of the beam. **07**

Q.5 Figure.2 shows a plan of the multi storeyed building only on shear walls, with a Floor height of 3.6m, Slab thickness 120mm, Floor finish load = 1kN/m^2, Live load 4kN/m^2, Beams 230 x 600 mm (total depth), SW_1 = 150 x 2000mm and 230 mm thick full height brick masonry walls only on grids A & B. Calculate seismic weight and centre of the mass of an intermediate storey. Also calculate the length of the Shear Wall SW_2 assuming width as 150mm so as to make static eccentricity equals to zero. Neglect the self weight of the shear walls and their stiffness in weaker direction. **14**

OR

Q.5 **(a)** A building with plan as shown in the figure.3 has frame stiffness of $K_A = K_C = K_2$ = 3000kN/m and $K_B = K_1 = K_3$ = 6000kN/m. If earth quake storeys shear of 60kN acts along X direction, calculate the forces on each frame considering torsion. Assume mass is symmetric in the plan. **14**

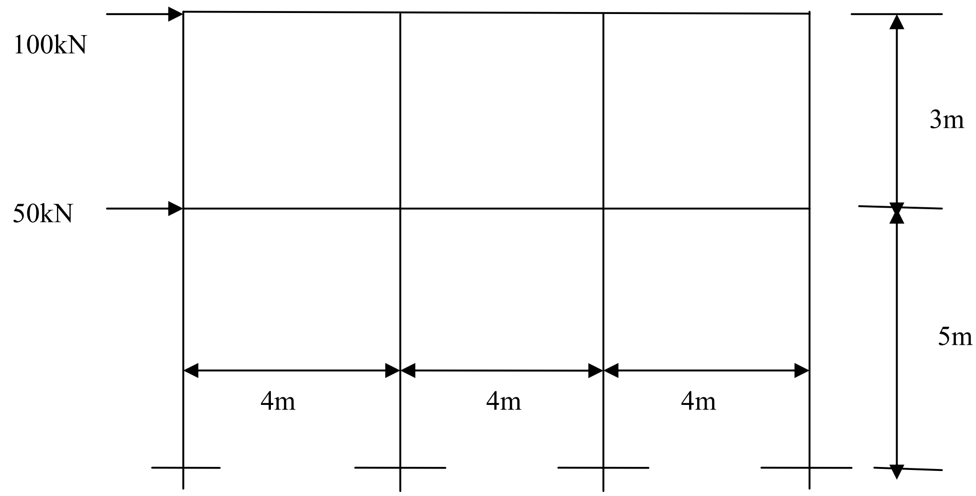

Figure.1

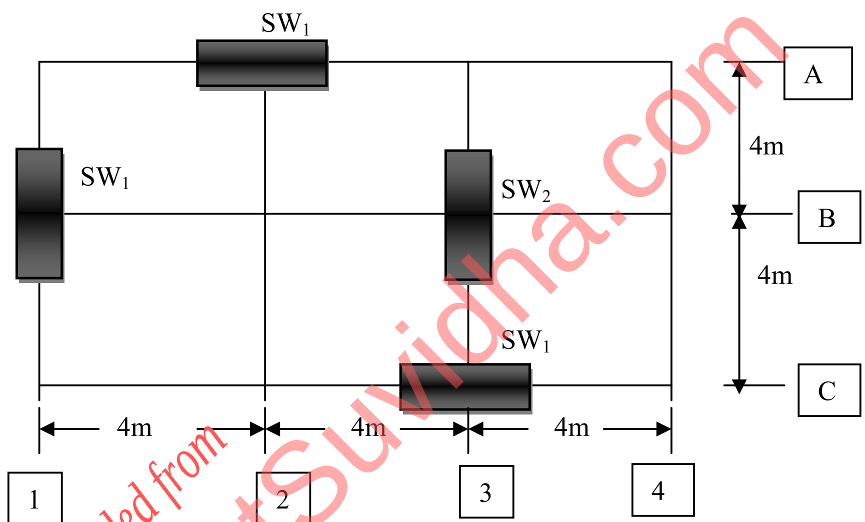

Figure . 2

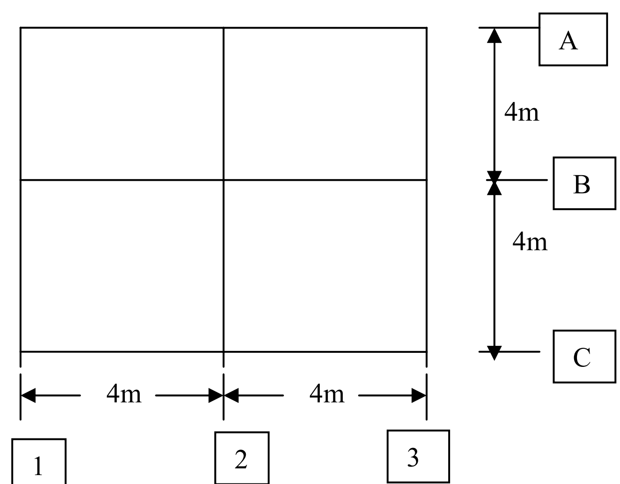

Figure . 3

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