Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – WINTER 2012

Subject code: 732002 **Date: 26/12/2012**

Subject Name: Design of Earthquake Resistant Structures

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. **Assume concrete grader M20 & Fe 415 steel grade unless otherwise mentioned.**
5. **Use of IS:1893, IS:4326, IS:13920, IS:456 and SP:16 is permitted in exam hall provided they do not contain anything other then the printed matter inside.**

Q.1 **(a)** Explain the following in Earthquake Engineering **09**

1) Provisions in IS-1893-2002 for design of a building with soft storey.
2) Liquefaction of foundation soil.
3) Static Eccentricity, Accidental Eccentricity, Design Eccentricity.

(b) List all the load combinations to be considered for a building with non-orthogonal moment resisting frames, if earthquake force is considered in all 3 directions and wind load is neglected. **05**

Q.2 **(a)** Explain the Capacity, Demand, ADRS Format and performance point in Push Over Analysis. **07**

(b) Explain Elastic Response Spectrum and Inelastic Response Spectrum. **07**

OR

(b) Describe the Capacity Design Concept in Ductile Detailing of RCC Beams as per IS:13920-1993. **07**

Q.3 **14**

Main Steel provided in various beams in Figure 1, is as follows:

Beam No.	Size (b X D)	Continuous Top Bars	Extra Top Bars on Left	Extra Top Bars on Right	Continuous Bottom Bars
B05	230 X 570	2-20 dia.	2-20 dia.	3-20 dia.	4-20 dia.
B01	230 X 570	2-16 dia.	2-20 dia.	2-20 dia.	4-16 dia.

Assume the Main Steel provided in beams B05 & B07 satisfies IS:13920 provisions, and Check the safety of column (size = 300 mm X 460 mm) at location A-3, if it carries factored axial load of 750 kN and main steel provided is 8 nos. 25 diameter tor steel bars. (check only main steel and assume stirrups as suitably provided.)

OR

Q.3 Describe Base Isolation Techniques and use of Dampers in improvement of seismic behavior of structures. **14**

Q.4 A shear wall 200 mm thick, with boundary elements 450 X 450 mm each (at 2000 mm center to center) is subjected to axial force Pu = 1600 kN, bending moment Mu = 4500 kNm, and shear force Vu = 2500 kN. Design the reinforcement in the wall using 10 mm dia bars and main steel in boundary elements. **14**

OR

Q.4 Describe the methods of Retrofitting of RCC Column and Footing in a framed structure building and Introduction of Lintel Band in an Existing Masonry Building. Draw suitable sketches to explain. **14**

Q.5 . Figure 1 shows a building and its vertical section with SMRF on medium soil in Surat for office purpose. **14**

- ⇨ Assume Slab thickness = 100 mm, Floor finish = 1.0 kN/m^2, Live load on regular slab = 4.0 kN/m^2 and Live load on roof = 1.0 kN/m^2
- ⇨ All beams of size 230 mm x 570 mm (including slab)
- ⇨ Consider full height brick walls in ground & first floor with 230 mm thickness on beams around outer periphery and no wall on all other beams.
- ⇨ Consider Column C_A = 300 mm x 460 mm, C_B = 460 mm x 300 mm and Shear wall SW_1 = 150 mm x 1500 mm.
- ⇨ Neglect the self weight & space occupied by the columns & shear wall.

Calculate the Base shear and shear force at Level 3 if EQ acts along X direction.

OR

Q.5 Refer Figure 1, consider data as above, assume storey shear at Level 4 as 100 kN, and Calculate the Joint loads on each frame at that level due to EQ in Y direction. **14**

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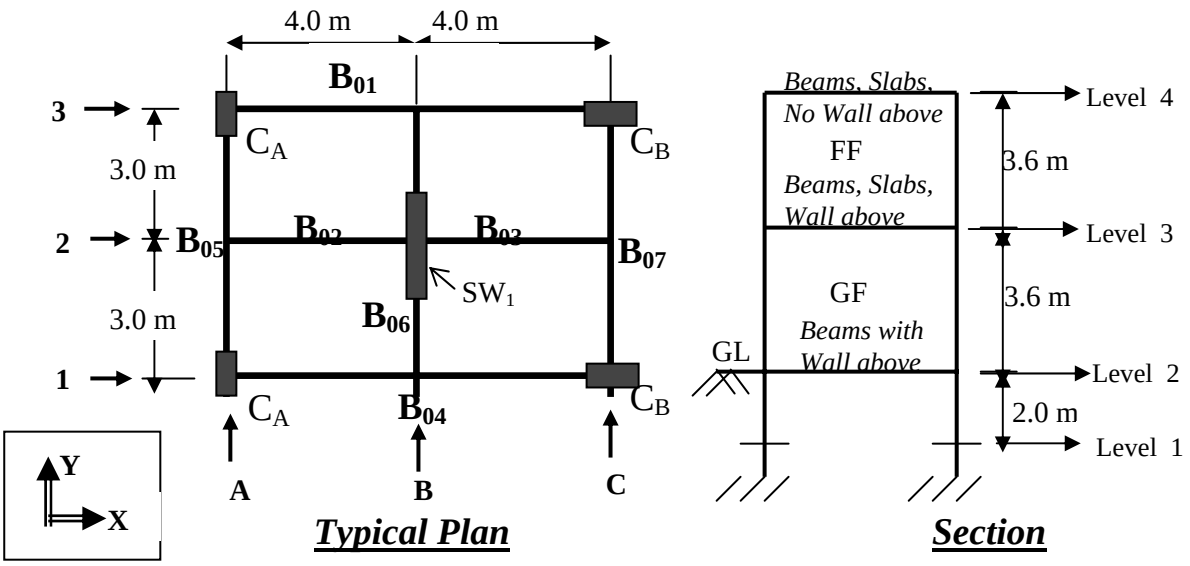
Figure – 1