Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – III • EXAMINATION – SUMMER • 2014

Subject code: 732002 Date: 05-06-2014

Subject Name: Design of Earthquake Resistant Structure

Time: 02:30 pm - 05:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary& mention same.**
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)** Describe the various types of dampers used for improvement of seismic performance of buildings. **07**

(b) Explain the method of determination of performance point in Push Over Analysis **07**

Q.2 **(a)** Explain Elastic Response Spectrum and Inelastic Response Spectrum. **07**

(b) . Explain the following in Earthquake Engineering **07**

1) Capacity Design Concept of Ductile Detailing.
2) Provisions in IS-1893-2002 for design of vertical projections beyond building

OR

(b) If a building on soft soil in Ahmedabad for Hospital, has a live load of 5 kN/sqmt. and a cantilever beam in the building has a span of 1.35 meters, udl of 25 kN/mt (due to dead load) and udl of 18 kN/mt (due to live load). Calculate the design bending moment at support of beam considering vertical EQ force only. **07**

Q.3 Figure 1 shows a building and its vertical section with SMRF on medium soil in Mumbai for Telecom purpose. **14**

- ⇨ Assume Slab thickness = 120 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 720 mm (including slab)
- ⇨ Consider full height brick walls in ground & first floor with 230 mm thickness on beams around outer periphery and 115 mm thick wall on all other beams.
- ⇨ Consider Column C_A = 300 mm x 600 mm, C_B = 600 mm x 300 mm and Shear wall SW_1 = 120 mm x 1750 mm.
- ⇨ Neglect the self weight & space occupied by the columns & shear wall.

Calculate the Base shear if EQ acts along X direction.

OR

Q.3 Refer Figure 1, consider data as Q.3 above, assume storey shear at level 4 as 160 kN, and Calculate the Joint loads on each frame at that level due to EQ in Y direction. **14**

Q.4 Main Steel provided in various beams in Figure 1, is as follows: **14**

Beam No.	Continuous Top Bars	Extra Top Bars on Left	Extra Top Bars on Right	Continuous Bottom Bars
B04	2-20 dia.	2-20 dia.	3-20 dia.	5-20 dia.
B05	2-16 dia.	2-20 dia.	2-20 dia.	4-16 dia.

Assume the Main Steel provided in beams B04 satisfies IS:13920 provisions, and Design Confinement Shear Reinforcement in B04 left support if the dead load udl is 45 kN/m and live load udl is 20 kN/m.

OR

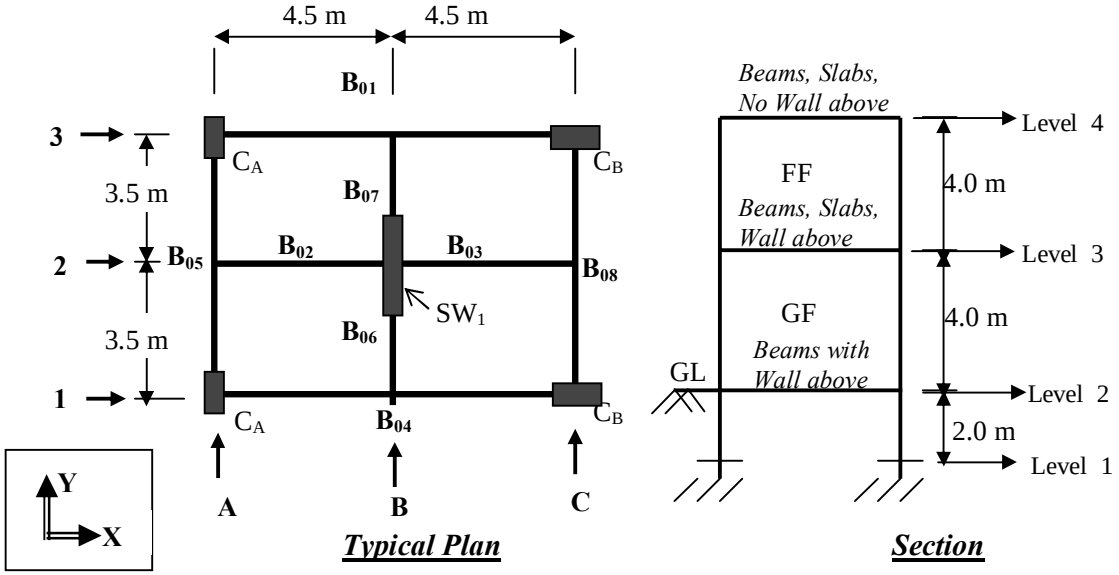
Q.4 Assume the Main Steel provided in beams B04 & B05 satisfies IS:13920 provisions, and Check the safety of column (between level 2 & 3) at location A-1, if it carries factored axial load of 900 kN and main steel provided is 10 nos. 20 diameter tor steel bars. (check only main steel and assume stirrups as suitably provided.) **14**

Q.5 A shear wall 150 mm thick, with boundary elements 450 X 450 mm each (forming out to out wall of 2000 mm) is subjected to axial force Pu = 1200 kN, bending moment Mu = 3000 kNm, and shear force Vu = 1000 kN. Design the reinforcement in the wall and main steel in boundary elements **14**

OR

Q.5 Describe the methods of Retrofitting of RCC Beam and Footing in a framed structure building and Retrofitting of a Masonry Building. Draw suitable sketches to explain. **14**

Figure – 1



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