Roll No												

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JAN 2023

Course Code: CIV 310

Course Name: Elements of Earthquake Engineering

Program & Sem: B.Tech (Civil), VI Sem (DE)

Date: 27 January 2023

Time: 9:30am to 12:30pm

Max Marks: 100

Weightage: 50%

Instructions:

(i) Read the all questions carefully and answer accordingly
(ii) Question paper consists of 3 parts.
(iii) Scientific and Non-programmable calculators are permitted.
(iv) Data Sheet is attached for reference

Part A [Memory Recall Questions]

Answer all the Questions. Each question carries ten marks. (3Q x 10M = 30M)

1. What is Elastic Rebound Theory? Explain with neat sketch. (C.O.No.1) [Knowledge]

2. Determine the center of mass and center of stiffness for the plan shown in Fig 1. All the columns have same stiffness. (C.O.No.2) [Comprehension]

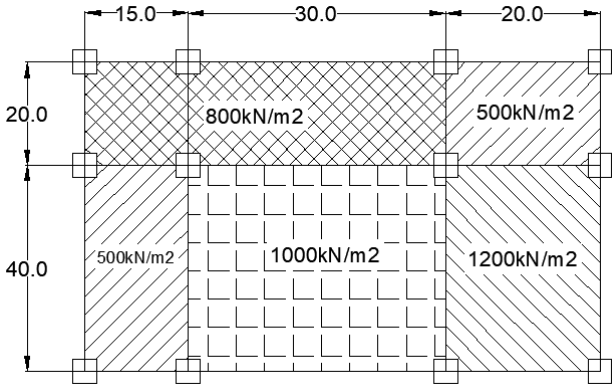

Fig 1

3. Explain any two lateral load resisting system. (C.O.No.2) [Knowledge]

Part B [Thought Provoking Questions]

Answer all the Questions. Each question carries fifteen marks. (3Q x 15M = 45M)

4. As an intern at the National Centre for Seismology, you have been asked to study all the past earthquakes that occurred in India and these modes of propagation. What are all the possible ways in which seismic waves travel? (C.O.No.1) [Comprehension]

5. You are the chief design engineer of a construction consultancy. The latest project you are working on is a 10 storey hospital project in Guwahati. As a collaboration with IIT Guwahati, as part of a research project, you decided to do linear dynamic seismic analysis of the structure. Suggest one method to do the same and explain its steps. (C.O.No.3) [Comprehension]

6. A 10-storey OMRF building has plan dimensions as shown in Fig. 2. The storey height is 3.0 m. The DL per unit area of the floor is 4kN/m^2. The intensity of live load on each floor is 3kN/m^2 and on the roof is 1.5kN/m^2. The soil below the foundation is hard and the building is located in Delhi. Determine the seismic forces and shears at different floor levels using static method

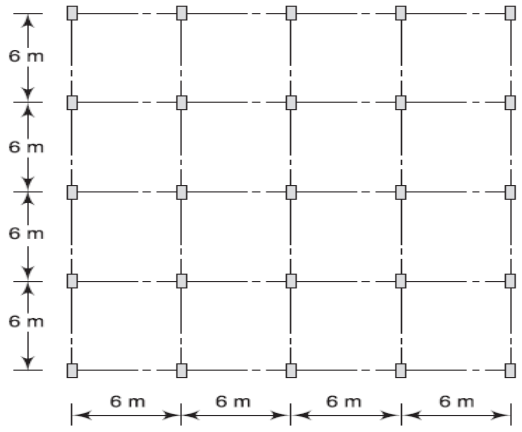

Fig 2

(C.O.No.3) [Application]

Part C [Problem Solving Questions]

Answer the Question. The question carries twenty five marks. (1Q x 25M = 25M)

7. A three-storey RCC school building has a plan area of 8m x 8m and the typical storey height is 3.5m. The building is located in seismic zone V. The type of soil encountered is medium stiff and it is proposed to design the building with a special moment resisting frame with infill. The intensity of DL is 10 kN/m^2 and LL is 4 kN/m^2 on all floors. Determine the design seismic loads on each floor of the structure by dynamic analysis. Consider all modes.

Storey level	Natural period (s)	Mode 1	Mode 2	Mode 3
3	0.134	1.00	1.00	1.00
2	0.191	–2.038	–0.489	0.81
1	0.533	1.611	–1.223	0.45

(C.O.No. 3) [Application]

DATA SHEET

Seismic Zone Factor	II	III	IV	V
(1)	(2)	(3)	(4)	(5)
Z	0.10	0.16	0.24	0.36

Sl No. (1)	Structure (2)	*I* (3)
i)	Important service and community buildings or structures (for example, critical governance buildings, schools), signature buildings, monument buildings, lifeline and emergency buildings (for example, hospital buildings, telephone exchange buildings, television station buildings, radio station buildings, bus station buildings, metro rail buildings and metro rail station buildings), railway stations, airports, food storage buildings (such as warehouses), fuel station buildings, power station buildings, and fire station buildings), and large community hall buildings (for example, cinema halls, shopping malls, assembly halls and subway stations)	1.5
ii)	Residential or commercial buildings [other than those listed in Sl No. (i)] with occupancy more than 200 persons	1.2
iii)	All other buildings	1.0

Sl No. (1)	Lateral Load Resisting System (2)	R (3)
i)	**Moment Frame Systems**	
	a) RC buildings with ordinary moment resisting frame (OMRF) (*see* Note 1)	3.0
	b) RC buildings with special moment resisting frame (SMRF)	5.0
	c) Steel buildings with ordinary moment resisting frame (OMRF)(*see* Note 1)	3.0
	d) Steel buildings with special moment resisting frame (SMRF)	5.0

For Static Method

$$\frac{S_a}{g} = \begin{cases} \text{For rocky or hard soil sites} & \begin{cases} 2.5 & 0 < T < 0.40 \text{ s} \\ \frac{1}{T} & 0.40 \text{ s} < T < 4.00 \text{ s} \\ 0.25 & T > 4.00 \text{ s} \end{cases} \\ \text{For medium stiff soil sites} & \begin{cases} 2.5 & 0 < T < 0.55 \text{ s} \\ \frac{1.36}{T} & 0.55 \text{ s} < T < 4.00 \text{ s} \\ 0.34 & T > 4.00 \text{ s} \end{cases} \\ \text{For soft soil sites} & \begin{cases} 2.5 & 0 < T < 0.67 \text{ s} \\ \frac{1.67}{T} & 0.67 \text{ s} < T < 4.00 \text{ s} \\ 0.42 & T > 4.00 \text{ s} \end{cases} \end{cases}$$

Table 10 Percentage of Imposed Load to be Considered in Calculation of Seismic Weight

(*Clause* 7.3.1)

Sl No.	Imposed Uniformity Distributed Floor Loads kN/m²	Percentage of Imposed Load
(1)	(2)	(3)
i)	Up to and including 3.0	25
ii)	Above 3.0	50

b) For use in response spectrum method [*see* Fig. 2(b)]

$$\frac{S_a}{g} = \begin{cases} \text{For rocky or hard soil sites} \begin{cases} 1+15T & T < 0.10 \text{ s} \\ 2.5 & 0.10 \text{ s} < T < 0.40 \text{ s} \\ \dfrac{1}{T} & 0.40 \text{ s} < T < 4.00 \text{ s} \\ 0.25 & T > 4.00 \text{ s} \end{cases} \\ \text{For medium stiff soil sites} \begin{cases} 1+15T & T < 0.10 \text{ s} \\ 2.5 & 0.10 \text{ s} < T < 0.55 \text{ s} \\ \dfrac{1.36}{T} & 0.55 \text{ s} < T < 4.00 \text{ s} \\ 0.34 & T > 4.00 \text{ s} \end{cases} \\ \text{For soft soil sites} \begin{cases} 1+15T & T < 0.10 \text{ s} \\ 2.5 & 0.10 \text{ s} < T < 0.67 \text{ s} \\ \dfrac{1.67}{T} & 0.67 \text{ s} < T < 4.00 \text{ s} \\ 0.42 & T > 4.00 \text{ s} \end{cases} \end{cases}$$