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Total number of printed pages:3

8th Semester/B.Tech/UCE 818

2023
(JUNE)

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

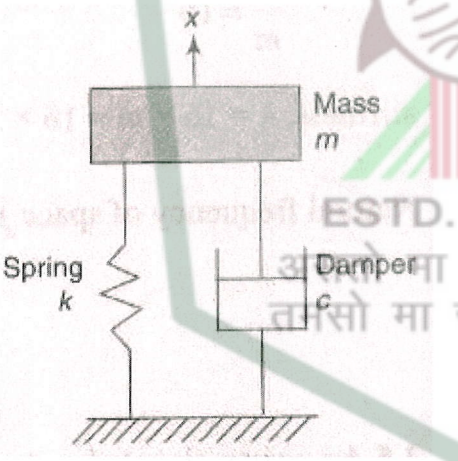
Full Marks: 100

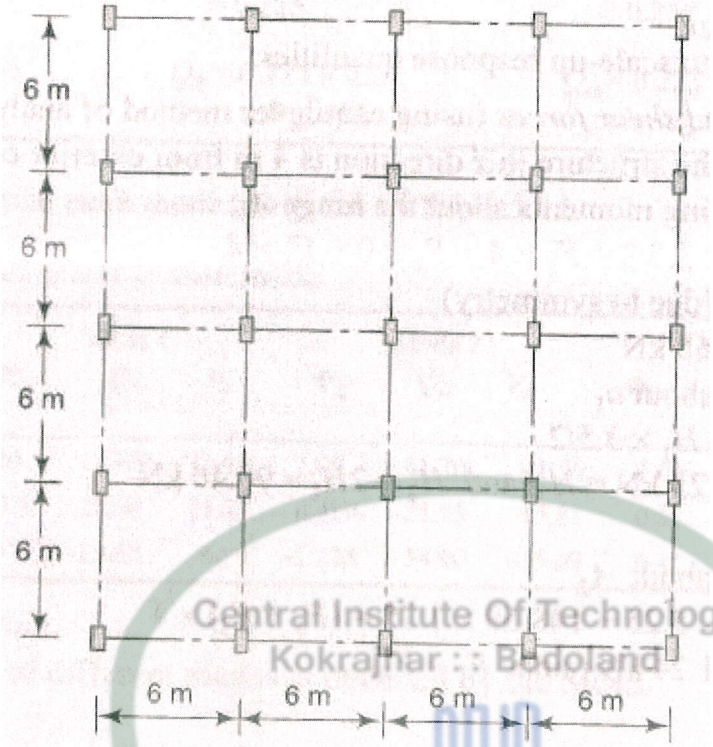
Time: Three hours

The figures in the margin indicate full marks for the questions.

*Answer **all** questions.*

ANY IS CODE IS NOT ALLOWED IN EXAMINATION HALL

		Question body	Marks
1.	a)	Describe the importance of ductility in earthquake resistant reinforced concrete structures. Explain the ductile detailing general specifications, in flexural members and longitudinal reinforcements as per IS 13920:1993.	3+7=10
	b)	Describe the structural irregularities on building configuration systems as per IS 1893(Part 1):2002	10
2	a)	A single degree of freedom system is modeled as shown in figure. It has the following properties, mass, m= 2 kg, stiffness, k= 15000N/m, coefficient of damping, c= 45 N-Sec/m. Determine natural circular frequency, damping factor and damped frequency of the system 	10
	b)	Describe the types of damages observed during past earthquakes in reinforced concrete buildings in India.	10
3	a)	Explain the various local site effects of earthquakes.	6
	b)	Explain plate tectonic theory and Reid's elastic rebound theory	3+5=8
	c)	Deduce the equation for free vibration with viscous damping.	6
4	a)	A 10 storey OMRF building has plan dimensions as shown in figure. The storey height is 3.0 m. The DL per unit area of the floor is 4 kN/m^2, the intensity of live load on each floor is 3 kN/m^2. The soil below the foundation is hard and the building is located in zone IV. Determine the seismic forces and shears at different floor levels	20

			
5	a)	Define seismic intensity and earthquake magnitude. Explain about Richter scale and how earthquake magnitude is measured with Richter scale?	4+4+4=12
	b)	Differentiate free vibration and forced vibration. Explain degree of freedom with proper example	3+5=8

a) For use in equivalent static method [*see* Fig. 2(a)]:

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

Table 3 Seismic Zone Factor *Z*
(*Clause* 6.4.2)

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

Table 8 Importance Factor (*I*)
(*Clause* 7.2.3)

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

Table 9 Response Reduction Factor *R* for Building Systems
(*Clause* 7.2.6)

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
ii)	**Braced Frame Systems** (*see* Note 2)	
	a) Buildings with ordinary braced frame (OBF) having concentric braces	4.0
	b) Buildings with special braced frame (SBF) having concentric braces	4.5
	c) Buildings with special braced frame (SBF) having eccentric braces	5.0