

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular), April-May 2018

B. Tech in Civil Engineering, Semester VI

Roll No.....

CE627 : Earthquake Engineering

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. IS 1893 -2002 part -I & IS 13920 (1993), SP-16 are permitted.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. Which of the following describes the buildup and release of stress during an earthquake?
(a) the Modified Mercalli Scale (b) the elastic rebound theory
(c) the principle of superposition (d) the travel time difference
- ii. Which of the following sequences correctly lists the different arrivals from first to last?
(a) P waves ... S waves.... Surface waves
(b) Surface waves ... P waves.... S waves
(c) P waves ... Surface waves ... S waves
(d) S waves ... P waves.... Surface waves
- iii. Part of the earth's core is believed to be liquid as indicating by information from the
(a) nature of meteorites (b) S-wave shadow
(c) Earth's magnetic field (d) P-wave shadow.
- iv. The size and shape of earth's core can be measured by information from the
(a) earth's weight (b) S-wave shadow zone
(c) nature of meteorites (d) P-wave shadow zone
- v. A weak storey is one in which the storey lateral strength is less than _____ percent of that in the storey above.
- vi. The point within the Earth where seismic waves originate is:
(a) The epicenter. (b) The fault scarp.
(c) the origin (d) the focus
- vii. Shallow earthquakes, less than 20 km deep, are associated with _____.
(a) convergent plate boundaries. (b) divergent plate boundaries
(c) transform plate boundaries (d) all of these
- viii. Which of the following is characteristic of a tsunami?
(a) Very long wavelength. (b) Very fast moving.
(c) Very low amplitude in the open ocean. (d) all of these
- ix. Generally Intensity of earthquake....
(a) Increases away from the epicenter (b) Remains constant
(c) Decreases away from the epicenter (d) None of these

- x According to IS 1893 (Part 1) - 2002, the ratio (I/R) shall not be greater than_____.

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- Define response spectrum and discuss its significance
- Enlist the various seismic waves.
- How does "Elastic Rebound theory" play a role in design for seismic forces?
- Write types and effects of soil liquefaction.

Q.3A What is meant by the focus and epicenter of an earthquake? Name the two kinds of body waves and explain how they differ.

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Q.3B What are the various method for solving the differential equation of motion? State the conditions under which these are preferred. Derive a mathematical expression defining the dynamic displacement using d'Alembert 'principle.

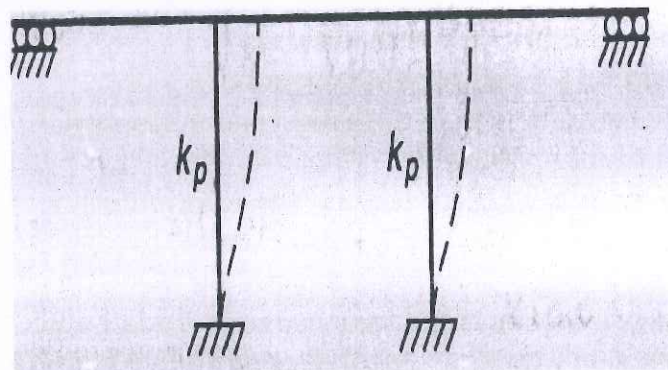
05

Q.4A Discuss how the mode shapes are used in the dynamic analysis of the building for calculating earth quake forces.

05

Q.4B A 120- m long pre stressed box girder is supported on four supports - Two abutments and two symmetrically located piers- as shown in figure. The cross sectional area of the deck is 12 m^2 . The weight of the deck is idealized as lumped; the unit weight of concrete is 25 kN/m^3 . The weight of the piers can be neglected. Each piers consists of Four 8-m tall columns of square cross sections, with $I_x = I_y = 0.12 \text{ m}^4$. Formulate the equation of motion governing free vibration in the longitudinal direction. Also find the natural circular frequency, natural period, and natural frequency of the free vibration of the deck slab. Modulus of elasticity of concrete $E = 28,000 \text{ MPa}$.

05



Q.5A A model of Two- storey RCC frame is shown in (Fig.A). Determine the natural frequency. Assuming the beam column joints to be rigid, for the following data.
Dimension of column $250 \times 250 \text{ mm}$.
Storey height = 3m.

05

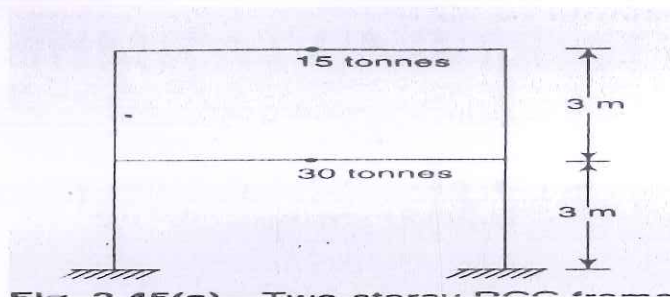


Fig.A(Two storey RCC Frame)

Q.5B Explain various irregularities found in the civil engineering structures from earthquake point of view. 05

Q.6A A machine foundation weighs 60 kN. The spring constant is 11000 kN/m and dash constant (C) = 200 kN-s/m. Explain 05

i) Whether the system is over damped, under damped or critically damped.

ii) Determine logarithmic decrement.

iii) Determine ratio of two successive amplitudes.

If the initial displacement is 10 mm and initial velocity is zero displacement at $t = 0.1$ s.

Q.6B Explain concept of ductile detailing & explain factor affecting the ductility of structures in detail. Explain ductile detailing of beam as per IS 13920 - 1993. 05

OR

Q.6B Write step by step procedure for seismic analysis of a three storey RC building as per IS 1893(PART 1): 2002 by response spectrum method. 05

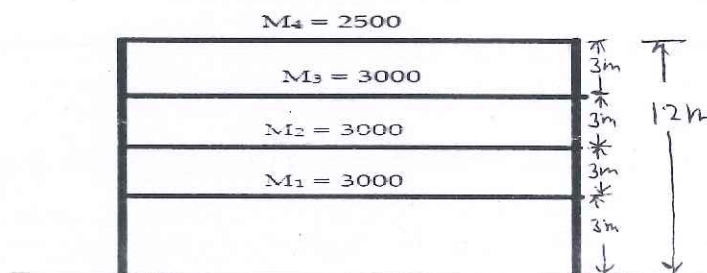
Q.7A Define seismology. Draw a typical seismograph system and explain its working. 05

Q.7B What do you mean by infill walls? How are they useful in making the structure earthquake resistant? Explain various modes/ mechanism for failure of infilled frame. 05

OR

Q.7B Explain the analysis of infill wall using equivalent diagonal strut for infill with and without openings. 05

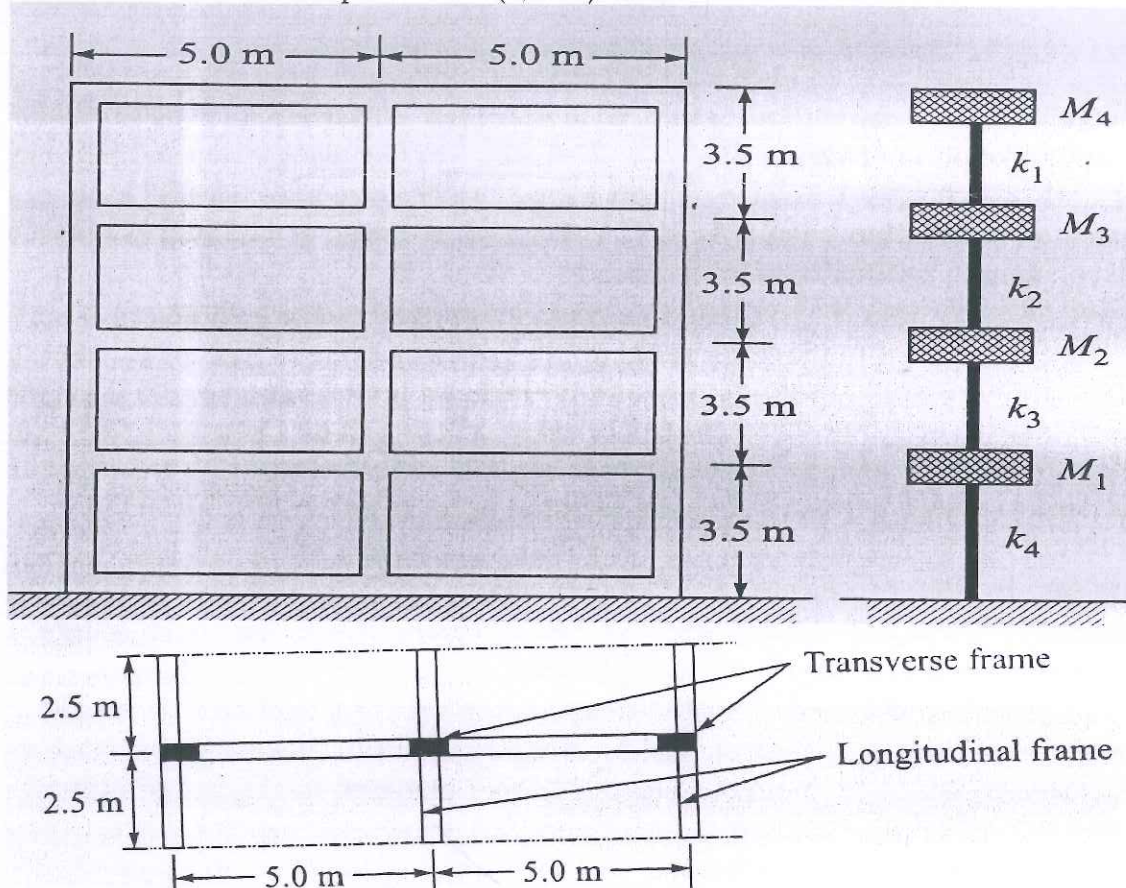
Q.8A A four -storey reinforced concrete frame building as shown, is situated at Jaipur. The height between the floors is 3 m and total height of the building is 12 m. The dead load and normal live load is lumped at respective floor. The soil below the foundation is assumed to be hard rock. Assume building is intended to be used as a hospital. Determine the total base shear as per IS 1893(Part 1): 2002 and compare with the earlier IS: 1893 codes. Distribute the base shear along the 15



height of the building.

Q.9 Determine the following in a Four storey RC building using equivalent static lateral force method as per IS 1893(Part 1): 2002:

15



- Fundamental natural period of vibration in seconds
- Design base shear
- vertical distribution of base shear also sketch the lateral force distribution at various floor levels

Given data : Lumped masses at various floors levels

$M_1 = M_2 = M_3 = 64.45$ ton and $M_4 = 37.08$ ton

OR

Q.9 A three storeyed hospital building located in Jaipur resting on medium soil is analyzed for free vibration and the results are as mentioned. 15

$W_1 = 1100$ kN, $W_2 = 1300$ kN and $W_3 = 1000$ kN.

$\omega_1 = 8.3407$ rad/sec.

$\omega_2 = 23.2831$ rad/sec and

$\omega_3 = 31.5954$ 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.