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CHAPTER

Earthquake Resistant Design of Structures

Q.1 Through dynamic analysis on a 3-storey building: the lateral forces on three floors (from the top) are 25 kN, 50 kN, 25 kN. If base shear obtained by static method is 150 kN, then the revised lateral forces at storey levels (from the top) are
(a) 37.5, 37.5, 75 kN (b) 37.5, 75, 37.5 kN
(c) 75, 37.5, 37.5 kN (d) 75, 37.5, 75 kN

Q.2 The seismic weight for a floor with dead load of 4 kN/m^2 and live load of 2.5 kN/m^2 is
(a) 6.5 kN/m^2 (b) 5.25 kN/m^2
(c) 4.625 kN/m^2 (d) 4 kN/m^2

Q.3 The seismic weight for a floor with dead load of 5 kN/m^2 and live load of 3.25 kN/m^2 is
(a) 5.625 kN/m^2 (b) 6 kN/m^2
(c) 6.5 kN/m^2 (d) 6.725 kN/m^2

Q.4 The RC fire station building having special RC moment resisting frame (SMRF) has the following design parameters. For seismic zone V, the one factor is 0.36. Response acceleration coefficient is 2.5. The design horizontal seismic coefficient is
(a) 0.105 (b) 0.135
(c) 1.1 (d) 1.5

Q.5 The design horizontal seismic coefficient is 0.09 and seismic weight 1000 kN. The design base shear is
(a) 50 kN (b) 80 kN
(c) 90 kN (d) 100 kN

Q.6 The regular 3-storey building has following plan dimensions 25 m × 25 m. Dead load on each floor is 3.5 kN/m^2 and dead load on roof is 3 kN/m^2. The live load on each floor is 3 kN/m^2 and live load on roof is 1 kN/m^2. The total seismic weight is
(a) 7000 kN (b) 7101.25 kN
(c) 7187.50 kN (d) 7215.75 kN

Q.7 For mode k, design horizontal acceleration spectrum is 0.5, mode shape coefficient at a floor is 0.6, modal participation factor is 0.25 and seismic weight on that floor is 2500 kN. Then peak lateral force at concerned floor in mode k is
(a) 16.25 kN (b) 17.75 kN
(c) 18 kN (d) 18.75 kN

Q.8 The peak storey shears acting on a storey in modes 1, 2 and 3 are 8 kN, –3 kN and 10 kN. The storey shear forces due to all modes considered, using square root of sum of squres, is
(a) 11.144 kN (b) 12.662 kN
(c) 13.153 kN (d) 15.555 kN

Q.9 The zone factor is an reasonable estimate of
(a) Peak magnitude of earthquake
(b) Peak ground velocity
(c) Peak intensity of earthquake
(d) Peak ground acceleration

Q.10 The base isolaters in structure
(a) Increase the strength of the structure
(b) Decrease the strength of the structure
(c) Decrease the natural period of the structure
(d) Increase the natural period of the structure

Q.11 Soft storey is one which has
(a) $k_i < 0.7\, k_{i+1}$ (b) $k_i > 0.7\, k_{i+1}$
(c) $k_i < 0.8\, k_{i+1}$ (d) $k_i > 0.8\, k_{i+1}$
Where, k_i is lateral stiffness of soft storey and k_{i+1} is lateral stiffness of storey above to it.

Q.12 In response spectrum method, the evaluation of storey shear is based on
(a) Normal mode
(b) First mode
(c) Number of modes upto 80% modal mass
(d) Number of modes upto 90% modal mass

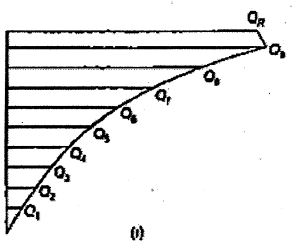
Q.13 The definition of the weak storey mainly considers the

(a) mass (b) stiffness
(c) strength (d) damping

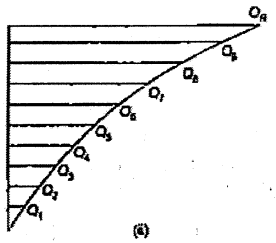
Q.14 The response reduction factors accounts for

(a) Ductility
(b) Redundancy
(c) Over strength of structure
(d) All of the above

Q.15 Which of following figure or figures illustrating distribution of forces along the height of 10-storey building may be correct?



(i)



(ii)

(a) Only (i) (b) Only (ii)
(c) Both (i) and (ii) (d) None of the above

Answers

1. (b)	2. (c)	3 (a)	4. (b)	5. (c)
6. (c)	7. (d)	8. (c)	9. (d)	10. (d)
11. (a)	12. (d)	13. (c)	14. (d)	15. (c)

Hints:

1. (b)
Base shear (by dynamic analysis)
= 25 + 50 + 25 = 100 kN
V_B' (150 kN) > V_B (= 100 kN)
⇒ Storey forces (from top)

$$25 \times \frac{150}{100} = 37.5 \text{ kN}$$

$$50 \times \frac{150}{100} = 75 \text{ kN}$$

$$25 \times \frac{150}{100} = 37.5 \text{ kN}$$

2. (c)
Seismic weight = Dead load + 0.25 × live load
(Because percentage of imposed load is taken as 25% for uniformly distributed imposed floor loads lesser and equal to 3 kN/m²)
Seismic weight = 4 + 2.5 × 0.25
= 4.625 kN/m²

3. (a)
Seismic weight
= 5 + 3.25 × 0.5
= 6.625 kN/m²

4. (b)

$$A_h = \frac{ZIS_a}{2Rg} = \frac{0.36 \times 1.5 \times 2.5}{2 \times 5} = 0.135$$

(For special moment resisting frame, R = 5 and for fire station building, I = 1.5)

5. (c)
The design base shear (V_B)
= $A_h W$ = 0.09 × 1000 = 90 kN

6. (c)
Floor are = 25 × 25 = 625 m²
Seismic weight of each floor
= (DL + 0.25 LL) × 625
= (3.5 + 0.25 × 3) × 625
= 2656.25 kN
Seismic weight of roof is
= DL × 625
= 3 × 625
= 1875 kN
Total seismic weight
= 2 × 2656.25 + 1875
= 7187.5 kN

7. (d)
$Q_{ik} = A_k \phi_{ik} P_k W_i$
= 0.05 × 0.6 × 0.25 × 2500
= 18.75 kN

8. (d)

$$V = \sqrt{8^2 + (-3)^2 + 10^2}$$

$$= \sqrt{64 + 9 + 100}$$

= 13.153 kN

36. (c)
For figure (i) comparatively less roof shear can be obtained if there is relatively less seismic load on it.

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