Duration: 4 Hours **[Max Marks:80]**

Instructions:

(1) Question No 1 is **compulsory**.
(2) Attempt any **three** questions out of the **remaining five.**
(3) All questions carry equal marks.
(4) Use of **relevant IS codes** permitted
(5) Assume suitable data, if required and state it clearly.

1 Attempt any **FOUR**

a Explain the importance of ductile detailing in earthquake resistant design of structures **05 M**

b Differentiate between static and dynamic loads. Explain different types of dynamic loads **05 M**

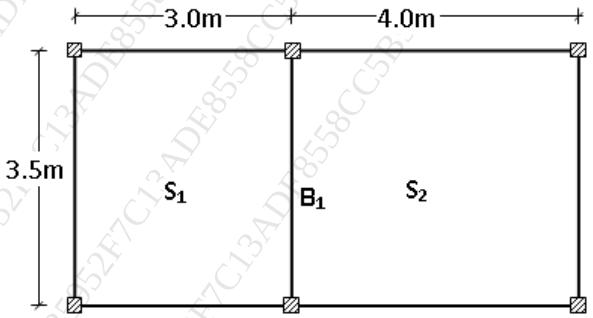
c Explain the structural behaviour of different components of a counterfort retaining wall **05 M**

d Distinguish between a rigid base and flexible base circular water tank based on their structural behaviour **05 M**

e What are the functions of longitudinal and transverse reinforcement in columns? **05 M**

2 a Design a circular water tank resting on ground for a capacity of 3 lakh litres. The water tank has a flexible base, walls and base slab are not monolithic with each other. Use M25 grade concrete and Fe 500 grade steel. Adopt WSM. Draw reinforcement details **12 M**

b Figure shows a slab beam system. The slabs S1 and S2 are having a thickness of 140mm, live load of 3 kN/m^2 and floor finish load of 1kN/m^2. The beam B1 is 250mm wide and 400mm deep. The beam is supporting a masonry wall of thickness 250mm and height 3m. Unit weight of masonry wall is 12 kN/m^3. Calculate the **total load** carried by beam **B_1** including its self-weight. **08 M**



3 a A prestressed concrete beam 250mm wide and 400mm deep is prestressed with steel wires of area 350mm^2. The wires are provided at a uniform eccentricity of 50mm with an initial prestress of 1250N/mm^2. The beam has a span of 10m. Determine the final stress (after losses) and percentage loss of stress in the steel wires for the following cases **10 M**

(i) The beam is pre-tensioned

(ii) The beam is post-tensioned

Take E_S = 210kN/mm^2. E_C = 35kN/mm^2

Shrinkage of concrete = 300 x 10^{-6} for pretensioned beam

= 215 x 10^{-6} for post tensioned beam

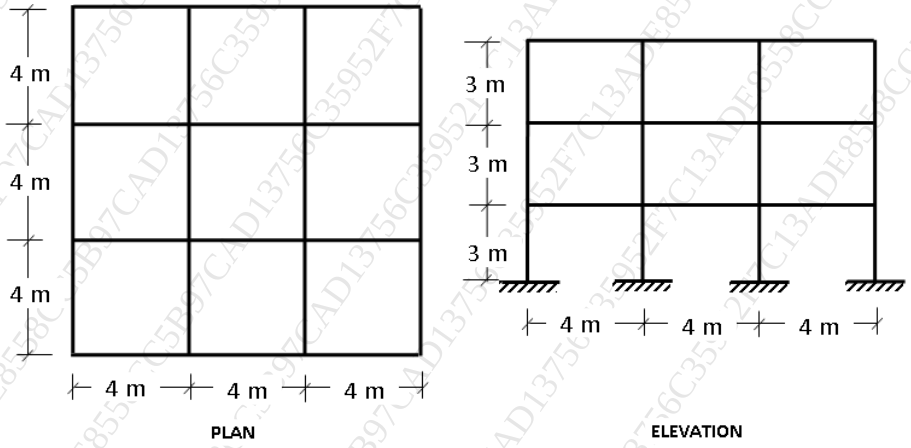
Relaxation of steel stress = 5% of initial stress

Creep coefficient = 1.6

Anchorage slip = 1.25 mm

Friction coefficient for wave effect = 0.0015per m

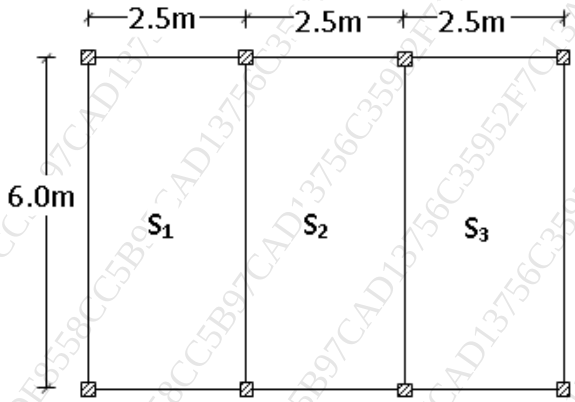
b It is proposed to construct a 3-storied railway station building as shown in the figures given, in Pune as a special moment resisting frame. Intensity of dead load on each floor = 12 kN/m^2. Intensity of live load = 4kN/m^2. Type of soil: Hard. Determine the total design base shear on the structure using seismic coefficient method as per IS 1893(Part 1): 2016. Also show the distribution of base shear at different floor levels **10 M**



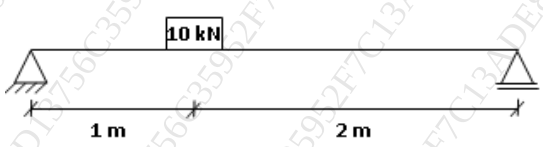
4 Design a suitable dog legged staircase for a room size of 3.5m x 5m and floor to floor height of 3.3m. Take live load as 3kN/m^2 and floor finish load as 1kN/m^2. Design both the flights and carry out the necessary serviceability checks. Draw functional plan showing dimensions of flights and midlanding **20 M**

Draw reinforcement details of both the flights. M20 grade concrete and Fe415 grade steel

5 a Figure shows the typical plan of an office building. live load on the slabs is 4kN/m^{2}and floor finish load 1kN/m^2. The slabs are supported on 230 mm thick beams on all sides. Design the continuous slabs S1-S2-S3 using IS Code coefficients. Adopt M20 concrete and Fe 500 steel. Carry out all serviceability checks. **14 M**



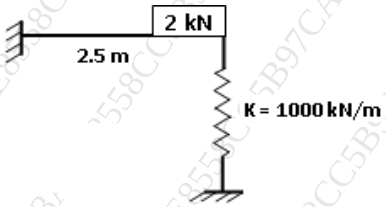
b Determine the natural frequency of following beams **06 M**



(a)

E = 2.5 x 10^4 MPa

I = 675 x 10^6 mm^4



(b)

E = 3.2 x 10^4 MPa

I = 520 x 10^6 mm^4

6 A reinforced concrete cantilever retaining wall is supporting a levelled backfill of height 4.2m above GL Depth of foundation is 1m below GL. Unit weight of backfill is 17kN/m^3 Angle of repose of soil is 28^0, SBC of soil is 180kN/m^2. Coefficient of friction between concrete and soil is 0.55. Design the stem and toe slab of the retaining wall. Carry out all stability checks. Draw reinforcement details of the retaining wall. Adopt M20 grade concrete and Fe 500 grade steel **20 M**