BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
First Semester 2023-24; CE F320: Design of Reinforced Concrete Structures
Mid-semester exam; 11-Oct-23

Duration: 90 minutes **Closed book (IS 456:2000 code allowed)** **MM. :**80

Instructions:

- Follow the provisions of IS 456:2000(Limit state design) only.
- In numerical type questions, full marks will not be given if detailed calculation steps are not presented.
- All given loads are to be considered as service/working/unfactored loads, unless mentioned otherwise.

Design aid:

Values of f_{sc} in MPa(N/mm^2) for Fe 415 steel and d'/d ratio are given in the table below(symbols have their general meaning).

f_{sc}				
Grade of steel	d'/d			
	0.05	0.10	0.15	0.20
Fe 415	355.1	351.9	342.4	329.2

Q.1 Fill in the blanks **[MM. 1 x 5 = 5]**

(a) T beam behaves as a rectangular beam if the neutral axis is present in_____.

(b) The effective span of simply supported beams is taken as the minimum of _____.

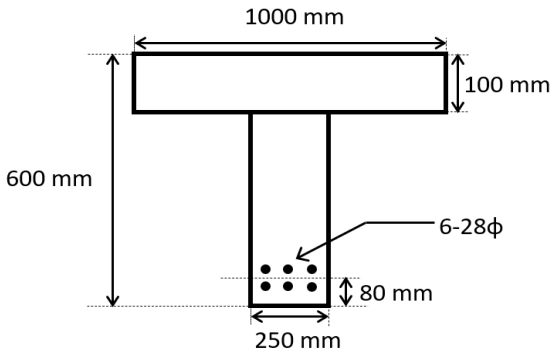
(c) Cracks caused by _____are perpendicular to the longitudinal axis of the beam.

(d) The maximum compressive strain in concrete under flexure; axial; combined axial and flexure is equal to _____; _____; _____, respectively.

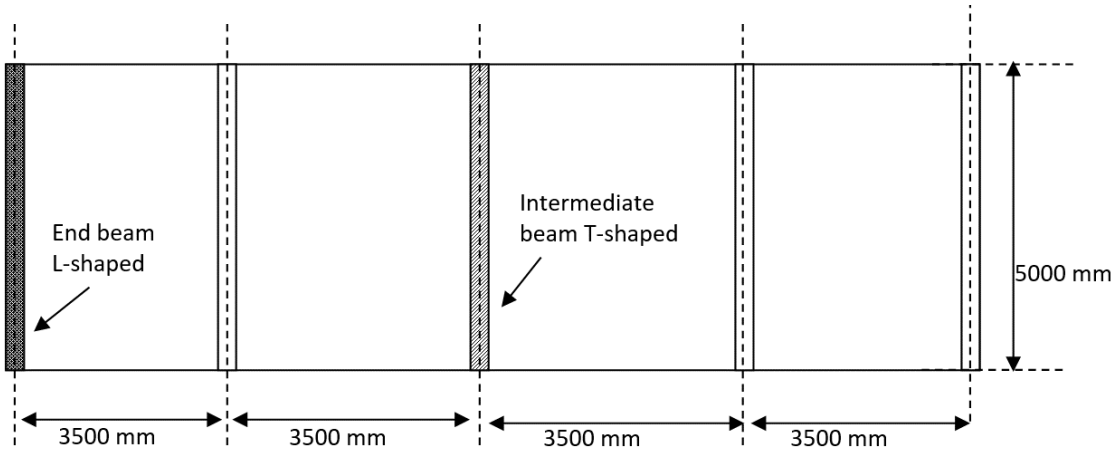
(e) The expression for calculating $x_{u,max}$ in terms of steel grade, steel modulus, and effective depth is _____.

Q.2 Design a rectangular beam for an effective span of 6 m. The beam has to carry a live load intensity of 10 kN/m, a concentrated live load of 30 kN placed at the mid-span point, and in addition to its self-weight a sustained dead load intensity of 5 kN/m. The overall dimension of the beam is restricted to 250 mm x 400 mm. Use M 25 grade concrete and Fe 415 grade steel. Take effective cover to reinforcement as 50 mm for initial trials. Also, sketch the reinforcement details provided at the most critical section. If required, Assume dia. of stirrups as 8 mm, maximum size of coarse aggregate as 20 mm, and moderate exposure condition. **[MM. 25]**

Q.3 Determine the ultimate moment carrying capacity of a simply supported **isolated** T-beam having an effective span of 6 m and a cross-section, as shown in the Figure below. The grade of concrete is M20, and that of steel rebars is Fe 250. **[MM. 25]**



Q.4 A T-beam floor consists of 100 mm thick RCC slab monolithic with 230 mm wide and 250 mm deep beams. The beams are spaced at 3.5m c/c and their effective span is 5 m, as shown in the Figure below. The grade of concrete and steel are M20 and Fe 415, respectively. The imposed load(excluding self-weight) on the slab is 5 kN/m^2. Calculate the tension reinforcement required for the **intermediate T beam**. Take effective cover as 40 mm. Also, sketch the cross-section and the main tension reinforcement details provided in the maximum bending moment section of the intermediate T beam. If required, Assume dia. of stirrups as 8 mm, maximum size of coarse aggregate as 20 mm, and mild exposure condition. **[MM. 25]**



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