1) **What are the assumptions made in limit state of design of collapse in flexure in single reinforced beam section?**

(a) *Plane sections normal to the axis remain plane after bending.* It means that the strain at any point in the cross-section is proportional to the distance from the neutral axis.

(b) *The maximum strain in concrete at the outermost compression fibre is taken as 0.0035 in bending.*

(c) *The relationship between the stress-strain distribution in concrete is assumed to be parabolic.*

For design purpose, the compressive strength of concrete is assumed to be parabolic, as shown in Fig. 4.1. For design purpose, the compressive strength of concrete is assumed to be 0.67 times the characteristic strength of concrete. The partial safety factor (rmc)=1.5 shall be applied in addition to this

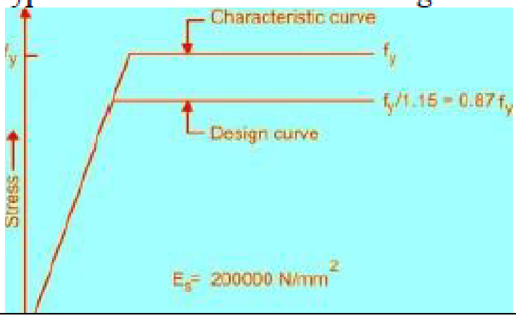
Maximum compressive stress in concrete =

$$0.67fck1.5$$

where fck= Characteristic strength of concrete.

(d) The tensile strength of the concrete is ignored.

(e) The stresses in the reinforcement are taken from the stress-strain curve for the type of steel used *as shown in Fig. 4.2.*



IAT-4 Solution.

(2) $b = 230mm$

$M_u = 200\ kN/m = 200 \times 10^6\ Nmm$

$f_y = 415\ N/mm^2$

$\frac{d'}{d} = \frac{50}{500} = 0.1$

$f_{sc} = 353\ N/mm^2$

Limiting moment of Resistance

$M_{u\,lim} = 0.36\, f_{ck}\, b \cdot x_{u\,max} (d - 0.42 x_u)$

$x_u = 0.48d$

$M_{u\,lim} = 158658048\ Nmm$

$M_{u_2} = M_u - M_{u\,lim}$

$= 200 \times 10^6 - 158658048$

$M_{u_2} = 41341952\ Nmm$

Area of tension steel.

$A_{st} = A_{st_1} + A_{st_2}$

$A_{st_1} = \frac{M_{u\,lim}}{0.87 f_y (d - 0.42 x_{u\,lim})}$

$= 1100.7\ mm^2$

$A_{st_2} = \frac{M_{u_2}}{0.87 f_y (d - d')} = 254.2\ mm^2$

∴ Area of steel $= A_{st_1} + A_{st_2} = 1354.9\ mm^2$

Provide 5-20mm dia tension steel.

3.

S.N	Working Stress Method	Limit State Method
1	It is easy for calculation.	It require more calculation so it make some difficult to design.
2	Materials strengths are not fully utilized in designing the member of structure.	Materials strengths are fully utilized in designing the member of structure.
3	It does not gives idea about the excess load which a structure can carry beyond the working load without collapse.	It gives idea about the excess load which a structure can carry beyond the working load without collapse.
4	In this method, Concrete and steel are considered elastic and the strain curve is linear for both.	This method is based on the actual stress strain curves for steel and concrete. For concrete the stress strain curve is nonlinear.
5	No factor of safety is used for loads.	Design load are obtained by multiplying partial safety factors of load to the working loads.
6	This method gives uneconomical design of structure.	This method gives economical design of structure.
7	In this method actual load, permissible stresses are according to serviceability approach.	In this method actual load, permissible stresses are according to probabilistic approach.

5.

5)

$\omega = 25$ kN/m

$f_{ck} = 30$ N/mm²

$f_y = 415$ N/mm²

Load

$w_u = w \times 1.5$

$= 37.5$ kN

$M_u = \frac{w_u l^2}{8} = \frac{37.5 \times 8^2}{8} = 300$ kNm

Limiting moment of resistance factor

$\frac{x_{umax}}{d} = 0.48$

$R_u = 0.36 f_{ck} \frac{x_{umax}}{d} \left(1 - \frac{0.42 x_{um}}{d}\right)$

$R_u = 4.13$

minimum eff required, $b = 250$ mm

$d_{req} = \sqrt{\frac{M_u}{R_u b}} = 580$ mm

Area of steel

$A_{st} = \frac{M_u}{0.87 f_y (d - 0.42 x_u)} = 1927$ mm²

$A_s = \frac{0.85\, b\, d}{f_y} = \frac{0.85 \times 250 \times 540}{415}$

$A_s = 276.5$ mm²

∴ No of bars = 4   provid 4-25mm ϕ bar.

6a

One Way Slab	Two Way Slab
One way slab is supported by beams in only 2 sides.	Two way slab is supported by beams in all four sides.
The ratio of longer span panel (L) to shorter span panel (B) is equal or greater than 2. Thus, L/B >= 2	The ratio of longer span panel (L) to shorter span panel (B) is less than 2. Thus, L/B < 2.
Main reinforcement is provided in only one direction for one way slabs.	Main reinforcement is provided in both the direction for two way slabs.

SN.	Short Column	Long Column
1	A column is said to be short if the ratio of effective length to its least lateral dimension is less than or equal to 12.	A column is said to be long if the ratio of effective length of column to its least lateral dimension is greater than 12.
2	The ratio of effective length of short column to its least radius of gyration is less than or equal to 40.	The ratio of effective length of a long column to its radius of gyration is greater than 40.
3	Buckling tendency is very low.	Long and slender columns buckle easily.
4	The load carrying capacity is high as compared to long column of same cross-sectional area.	The load carrying capacity of a long column is less as compared to short column of same cross- sectional area.
5	The failure of short column is by crushing.	The column generally fails in buckling.