Q.1. What is M 25?

Ans. M = Mix, and 25 represents the compressive strength of concrete in N/mm^2 at 28 days

Q.2. What is Fe 415?

Ans. Fe = Ferrous metal and 415 represents tensile strength of steel in N/mm^2

Q.3. How many grades of steel are used?

Ans. There are three grades of steel:

(1) Fe 250 - Mild steel
(2) Fe 415 - TOR steel (or) HYSD bar
(3) Fe 500 - TOR steel (or) HYSD bar

Q.4. What is a full form of "HYSD" bar and "TMT" bar?

Ans. HYSD = High Yield strength Deformed bar

TMT = Thermo Mechanically Treated bar

Q.5. Give the modulus of elasticity of steel.

Ans. $E_s = 2 * 10^5 N/mm^2$

Q.6. Give the value of partial safety factors for concrete and steel.

Ans. partial safety factor = 1.5 (concrete)

partial safety factor = 1.15 (steel)

Q.7. Find out cracking strength (or) tensile strength of concrete grade M 25.

Ans. $f_{cr} = 0.7 * \sqrt{fck}$ ... (IS:456-page-16)

$= 0.7 * \sqrt{25}$

$= 0.7 * 5 = 3.5 N/mm^2$

Q.8. Find out modulus of elasticity of concrete grade M 25.

Ans. $E_c = 5000 * \sqrt{fck}$ ... (IS:456-page-16)

$= 5000 * \sqrt{25}$

$= 5000 * 5 = 25000 N/mm^2$

Q.9. Find out design strength of concrete grade M 25.

Ans. Design strength of concrete = $0.446 * f_{ck} = 0.446 * 25 = 11.15 N/mm^2$

Q.10 Find out design strength of steel grade Fe 415.

Ans. Design strength of steel = $0.87 * f_y = 0.87 * 415 = 361.05$ N/mm^2

Q.11 Find out $X_{u\text{-}max}$ for Fe 415 and effective depth is 500 mm.

Ans. $X_{u\text{-}max} = 0.48 * d = 0.48 * 500 = 240$ mm … (SP:16-page-9) Table B

Q.12 Find out $M_{u\text{-}lim}$ for M 25, section of beam is 230 mm x 500 mm

Ans. $M_{u\text{-}lim} = 0.138 * f_{ck} * b * d^2$ … (SP:16-page-10) Table C

$= 0.138 * 25 * 230 * 500^2$

$= 198.375$ kN.m

Q.13 Calculate minimum and maximum % of steel for beam section 230 mm x 450 mm (effective) Take, Fe 415 and effective cover = 30 mm

Ans. $A_{st\text{-}min} = (b*d)*0.85 / f_y$ … (IS:456-page-46)

$= (230 * 450)* 0.85 / 415$

$= 211.98$ mm^2

$A_{st\text{-}max} = 0.04*b*D$

$= 0.04* 230* 480$

$= 4416$ mm^2

Q.14 Give the number of minimum bars are required for square and circular column.

Ans. Minimum No. of bars = 4 (Square/Rectangular)

Minimum No. of bars = 6 (Circular)

Q.15 Calculate bond strength of 20 mm diameter bar in Tension. Take: M 25, Fe 415

Ans. Design bond stress = $\tau_{bd} = 1.4 * 1.6 = 2.24$ N/mm^2

Q.16 Calculate bond strength of 20 mm diameter bar in compression. Take: M 30, Fe 500

Ans. Design bond stress = $\tau_{bd} = 1.5 * 1.6 * 1.25 = 3$ N/mm^2

Q.17 Find out development length for 16 mm diameter bars in Tension. Take: M 25, Fe 415

Ans. $L_d = \text{Ø}*0.87*f_y / 4*\tau_{bd}$ (SP:16:page-183)

$= (16*0.87*415)/(4*1.4*1.6) = 644.73$ mm

Q.18 Calculate minimum eccentricity for circular column of 600 mm diameter. Take unsupported length = 3 m.

Ans. $e_{min} = (L/500) + (D/30)$

$= (3000/500) + (600/30) = 26$ mm

Q.19 Calculate minimum and maximum % of main steel for circular column of 500 mm diameter.

Ans. $A_{sc\text{-}min} = 0.8\%*A_g = 0.8*(\pi/4*D^2)/100$

$= 0.8*(\pi/4*500^2)/100$

$= 1570.79\ mm^2$

$A_{sc\text{-}max} = 6\%* A_g = 6*(\pi/4*D^2)/100$

$= 6*(\pi/4*500^2)/100$

$= 11780.97\ mm^2$

Q.20 Calculate design Shear strength of concrete of M 25 having 1 % of steel.

Ans. τ_c = Design shear strength of concrete = 0.64 N/mm^2 (SP:16:Page-178)

Q.21 Give minimum % of main steel in slab for mild steel and HYSD bars.

Ans. $A_{st\text{-}min} = 0.15\% * b*D$ … (Mild steel)(Fe 250)

$= 0.12\% * b*D$ … (HYSD)(Fe 415 & Fe 500)

Q.22 What is the value of minimum diameter of main steel for column?

Ans. 12 mm

Q.23 What is the maximum distance between two main steel bars for column?

Ans. 300 mm

Q.24 Give the minimum clear cover for beam, slab, column and footing.

Ans. Clear cover = 20 mm (Beam) Clear cover = 20 mm (Slab)

Clear cover = 40 mm (Column) Clear cover = 50 mm (footing)

Q.25 Give the minimum no. of dowel bars provided in footing.

Ans. 4 Nos.

Q.26 What is the criteria to decide one-way (or) two-way slab?

Ans. if, $L_y / L_x >= 2$ (One way slab)

If, $L_y / L_x < 2$ (Two way slab) … (L_y = Longer span , L_x = shorter span)

Q.27 Where critical section for B.M. are taken for one way and two way shear in footing?

Ans. Critical section is taken at a distance of "d" from column face … (One way shear)

Critical section is taken at a distance of "d/2" from column face … (Two way shear)

d = effective depth of footing

Q.28 Calculate the flange width of T-beam from the following data:

Depth of flange = 120 mm

Width of rib = 300 mm

Effective span = 7 m

Ans. D_f = 120 mm , b_w = 300 mm, L_o = 7000 mm

b_f = Flange width = (L_o/6 + b_w + 6*D_f) … (IS:456-page-37)

= (7000/6 + 300 + 6*120)

= 2186.67 mm

Q.29 What is "limit state"?

Ans. "The acceptable limit for safety and serviceability requirements before failure occurs is called a limit state."

Q.30 Give the IS criteria for spacing of bars in slab.

Ans. Main steel:

Maximum spacing = 3*d (or) 300 mm whichever is less….(IS:456-page-46)

Distribution steel:

Maximum spacing = 5*d (or) 450 mm whichever is less….(IS:456-page-46)

Q.31 What is the maximum spacing of bars in beam for Fe 415?

Ans. 180 mm … (IS:456-page-46) Table-15

Q.32 Find out maximum pitch and minimum diameter of lateral ties for column 400 mm x 500 mm having 8 Nos. of 16 mm diameter bars as main steel.

Ans. Pitch: (1) b (or) D min = 400 mm … (IS:456-page-48)

(2) 16*$Ø_{small}$ = 16*16 = 256 mm

(3) 300 mm

Minimum of all values = 256 mm = Maximum pitch

Diameter of ties: (1) $\emptyset_{large}$ / 4 = 16/4 = 4 mm

(2) 6 mm

Maximum of above values = 6 mm = Minimum dia. of ties

Q.33 Find out the stress of dowel bars of Fe 415.

Ans. Stress in dowel bars = $0.75*f_y = 0.75*415 = 311.25\ N/mm^2$

Q.34 Find out modification factor for slab. Take Fe 415 and 0.6% steel

Ans. Select curve = $0.58*f_y = 0.58*415 = 240.7\ N/mm^2$,... (IS:456-page-37,38) – Figure-4

Modification factor = 1.15

Q.35 Find out Pt_{lim} for singly reinforced beam. Take: M 25, Fe 415

Ans. Pt_{lim} = 1.19 % … (SP:16-page-10) Table E

Q.36 Find out clear distance between each bar in footing having 20 Nos. of Ø 16 mm bars.

Take: Clear cover = 50 mm and width of footing = 3000 mm.

Ans. Clear distance = $\{(b_f – 2*C – \emptyset)/ (n – 1)\} - \emptyset$

$= \{(3000 – 2*50 – 16)/19\} – 16$

= 135.79 mm

Q.37 Find out minimum % of steel required for column of size 500 mm x 500 mm

Ans. $A_{sc\text{-}min} = 0.8\% * A_g$

$= 0.8 * 500*500 / 100$

$= 2000\ mm^2$

Q.38 Find out maximum % of steel required for circular column of diameter 400 mm

Ans. $A_{sc\text{-}max} = 6\% * A_g$

$= 6 * (\pi/4) * 400^2 / 100$

$= 7539.84\ mm^2$

Q.39 What is max. dia of bar for slab whose overall thickness is 120 mm ?

Ans. $\emptyset_{max}$ = D/8 = 120/8 = 15 mm

Q.40 Find out minimum dowel area for column of size: 500 mm x 500 mm

Ans. Minimum dowel area = $0.5\% * (b_c * b_c) = 0.5 * (500 * 500) / 100 = 1250\ mm^2$