WEDNESDAY

DESIGN OF DOUBLY REINFORCED SECTION

Step 1 : Computation of beam dimensions strain corresponding ആയിട്ടുള്ള stress ആണ് f_{sc} - ions, b, effective depth, overall depth, width of beam effective span.

Step 2 : Computation of loads and bending moment
DL, LL, TL, ultimate moment

Step 3 : check for singly / doubly reinfoced section
If the applied moment is larger than $M_{u\,limit}$ then it is a doubly reinforced Section.

Step 4 : Computation of depth of neutral axis
$\frac{x_u}{d}$ & $x_{u\,max}/d$

If $\frac{x_u}{d} < \frac{x_{umax}}{d}$ section is underreinforced, & it is safe. If $\frac{x_u}{d} > \frac{x_{umax}}{d}$ the section is over reinforced & code recomments redesign

Step 5: compute the area of tensile reinforcement (A_{st_1}) for the singly reinforced section for the moment $M_{u Limit}$

Step 6: Compute the value of compression reinforcement from the equation

$$M_u - M_{u limit} = f_{sc} A_{sc} (d - d')$$

Step 7: compute the value of A_{st_2} from the eqn

$$A_{st_2} = \frac{A_{sc} f_{sc}}{0.87 f_y}$$

The total area of tensile reinforcement shall be obtained from the eqn

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

Step 8: check for A_{st} & A_{sc}

[$A_{st min}$, $A_{st max}$, $A_{sc min}$, $A_{sc max}$]

compute the no. of bars in tension side and compression side.

Step 9: check for shear

[$\tau_v, \tau_c, \tau_{cmax}$]

Step 10: check for deflectⁿ [slenderness ratio < 20]

Step 11: Computation of development length

NOTE

If the applied moment is larger than the limitting moment 2 alternatives will be available.

1. To increase the depth of section
2. To provide compression reinforcement

In many cases the max value of depth of the section may be limitted or restricted from architectural considerations. In such cases the only alternative will be to provide compression reinforcement, giving rise to doubly reinforcement section.

A doubly reinforced section is therefore provided in the following circumstances

1. when there are architectural restrictions such as headroom requirements, appearances etc on the depth
2. Restriction in depth at the location of beam at plinth level along with the provision of ventilated between the ground level and the bottom of the plinth beam
3. It is required to ↑se the stiffness of the beam
4. It is found that the compression steel ↑ses the rotation capacity & ductility structures with high ductility responds better to seismic forces
5. In a continuous beam floor system where the beam acts as a T beam in the mid span and act as a rectangular beam at the support.

Q: Design a reinforced concrete beam supported on 2 walls 500 mm thick spaced at a clear distance of 6m. The beam carries a super imposed load of 30 kN/m. The size of the beam is restricted to 300 mm x 500 mm. Use M20 concrete and Fe415

Soln:

M_{20} $f_{ck} = 20\ N/mm^2$

Fe415 $f_y = 415\ N/mm^2$

$b = 300mm$

$D = 500mm$

$L.L = 30kN/m$