SUMMARY OF SHEAR DESIGN

Preliminary design

Estimate the beam dimensions using the following equations.

$b_w d^2 = K_\ell M_d$ and $b_w d = 0.9 V_d / f_{ctd}$

Final Design

1. Calculate the design shear V_d at a distance "d" from the support face if the support is a direct support. For indirect supports, the critical section is at the face of the support.
2. Calculate V_{cr} and V_{max}

$V_{cr} = 0.65 f_{ctd} b_w d(\psi)$

If there is no axial force or $(N_d/A_c)<0.5$ MPa

take $\psi=1.0$

If N_d is compression, $\psi = 1 + 0.07 \frac{N_d}{A_c}$

Remember, N_d will be taken as (+)

If N_d is tension, $\psi = 1 + 0.3 \frac{N_d}{A_c}$

Remember, N_d will be taken as (-)

$V_{max} = 0.22 f_{cd} b_w d$

(a) If $V_d > V_{max}$, change the size of the beam

(b) If $V_d \le V_{cr}$, minimum shear reinforcement should be used.

$$\min \frac{A_{sw}}{s} = 0.3 \frac{f_{ctd}}{f_{ywd}} b_w$$

(c) If $V_{cr} < V_d < V_{max}$, design the shear reinforcement.

$$\frac{A_{sw}}{s} = \frac{V_d - V_c}{f_{ywd} d} \ge \min\left(\frac{A_{sw}}{s}\right)$$

$V_c = 0.52 f_{ctd} b_w d$

$s \le d/2$

If the shear is high ($V_d \ge 0.7 V_{max}$) decrease the spacing to d/4.

In seismic regions, both ends of the beam should be confined with closely spaced ties. According to the Turkish Seismic Code, the length of the confined zone should be twice the beam depth (2h). Spacing in these zones should not be more than d/4.

Columns also have confined zones at each end where the maximum tie spacing should be 100 mm.