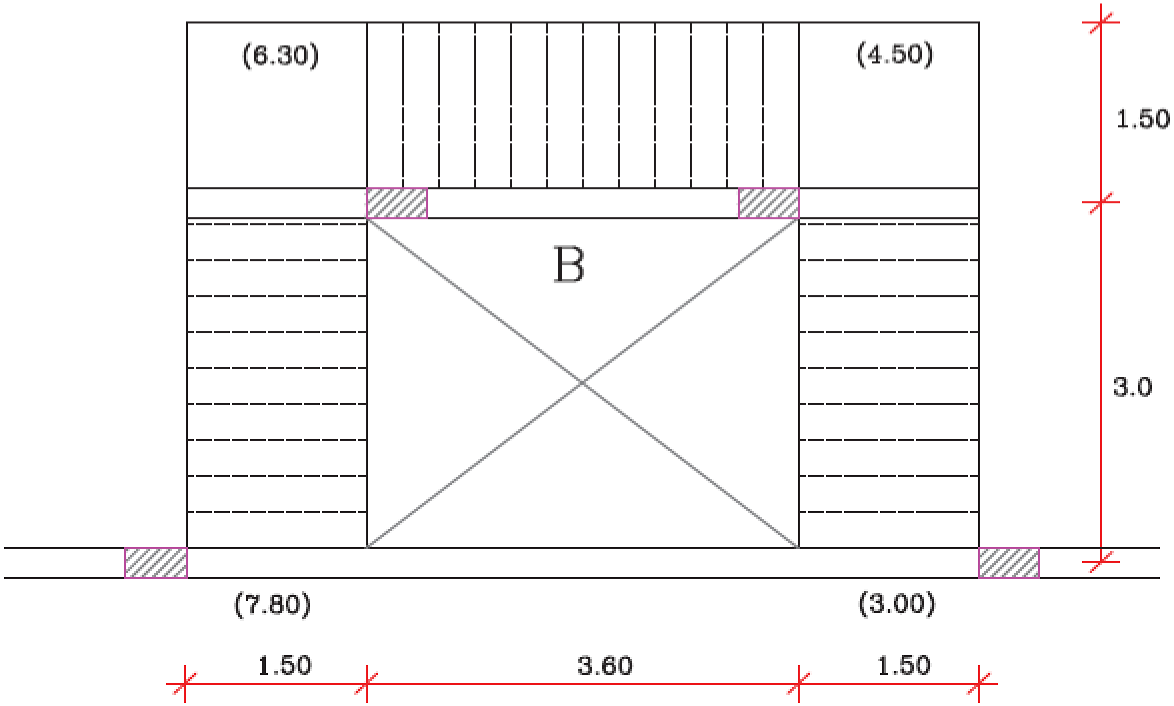
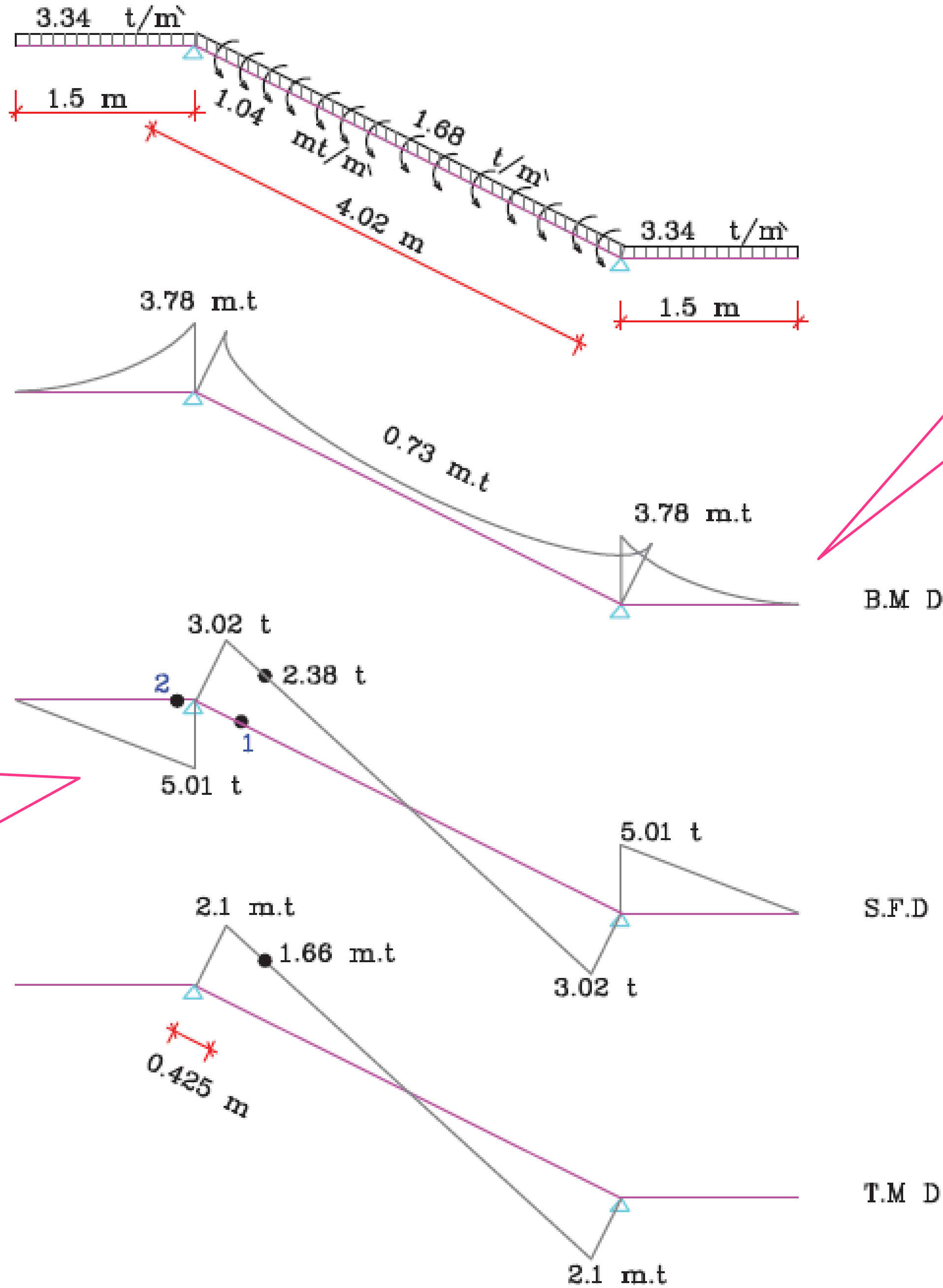
Ex: design beam B (300x600)





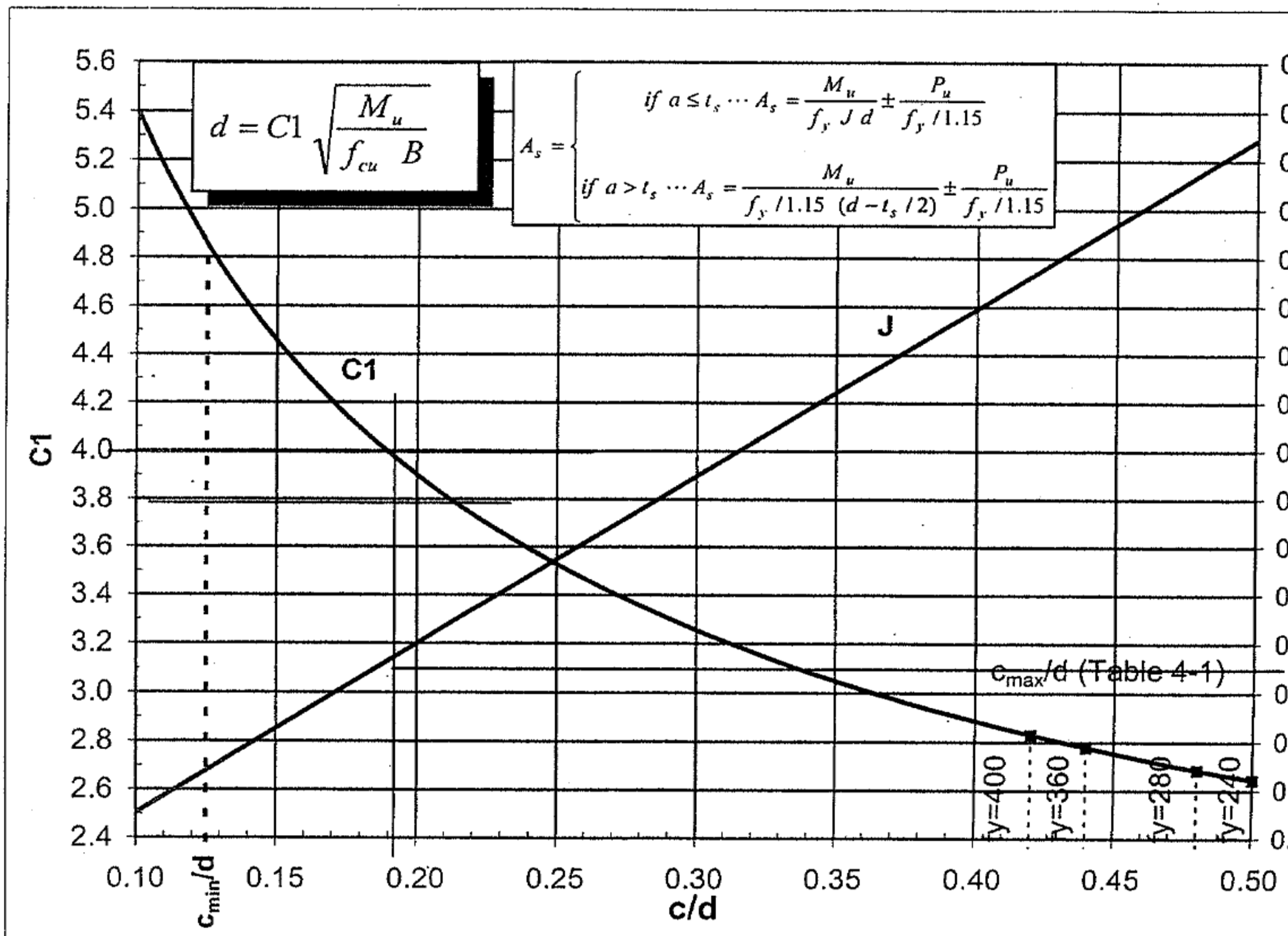
Design for max –ve B.M = 3.78 m.t

Design for shear in 2 sections, **sec 1** for shear and torsion, and **sec 2** for shear only (max shear Q= 5.01 t)

DESIGN CHART FOR SECTIONS SUBJECTED TO SIMPLE BENDING (R and T-sections)

FOR ALL GRADES OF STEEL AND CONCRETE

C1	J	c/d	c_{max}/d
2.65	0.696	0.500	fy=240
2.69	0.703	0.480	fy=280
2.78	0.717	0.440	fy=360
2.83	0.723	0.420	fy=400
2.90	0.732	0.395	
2.95	0.738	0.379	
3.00	0.743	0.364	
3.05	0.748	0.350	
3.10	0.753	0.337	
3.15	0.757	0.324	
3.20	0.761	0.312	
3.25	0.765	0.301	
3.30	0.768	0.291	
3.35	0.772	0.281	
3.40	0.775	0.272	
3.45	0.778	0.263	
3.50	0.781	0.254	
3.55	0.784	0.246	
3.60	0.787	0.239	
3.65	0.789	0.231	
3.70	0.791	0.225	
3.75	0.794	0.218	
3.80	0.796	0.212	
3.85	0.798	0.206	
3.90	0.800	0.200	
3.95	0.802	0.194	
4.00	0.804	0.189	
4.05	0.806	0.184	
4.10	0.807	0.179	
4.15	0.809	0.175	
4.20	0.810	0.170	
4.25	0.812	0.166	
4.30	0.813	0.162	
4.35	0.815	0.158	
4.40	0.816	0.154	
4.45	0.817	0.150	
4.50	0.818	0.147	
4.55	0.820	0.143	
4.60	0.821	0.140	
4.65	0.822	0.137	
4.70	0.823	0.134	
4.75	0.824	0.131	
4.80	0.825	0.128	
4.85	0.826	0.125	



- Design for moment: sec of beam 300x600

$$d = C1\sqrt{\frac{M_u}{f_{cu}\ B}}$$

$600-50 = c1(3.78*1.5*10^5)^{-1/2}$

c1 ≥ 4.85   take j = 0.826

$$As = \frac{3.78 * 1.5 * 10^5}{0.826 * 3600 * 55} = 3.46\ cm^2$$

$$As_{min} = \left(\frac{11}{Fy}\ b*d\right) \quad or \quad 1.30\ As_{req.}$$

$$= \left(\frac{11}{3600}\ 30 * 55\right) \quad or \quad 1.30 * 3.46$$

$$= 5.04\ cm^2 \quad or \quad 4.50\ cm^2$$

$\therefore As = 4.50\ cm^2$ 3Φ16

Check Shear + Torsion :

sec 1 :– (critical section)

**** critical section at $\frac{c+d}{2} = \frac{0.3+0.55}{2} = 0.425$ m

$Q_{cr} = 2.38 * 1.5$

$= 3.57$ t

$q_s = \frac{3.57 * 10^3}{30 * 55}$

$= 2.16$ kg/cm^2

$Mt = 1.66 * 1.5$

$= 2.50$ m.t

$$q_{tu} = \frac{M_{tu}}{(2 A_o . t_e)}$$

$A_o = 0.85 A_{oh}$

$t_e = A_{oh}/P_h$

$q_c < q_s < q_{max}$

$q_{ct} < q_t < q_{t\ max}$

use RFT for shear

use RFT for torsion

RFT for Shear :—

$$q = q_s - \frac{q_c}{2} = \frac{n * As * Fy/\gamma s}{b * s}$$

$$2.16 - \frac{1.45}{2} = \frac{2 * As * 2400}{30 * s * 1.15}$$

$$\frac{As}{s} = 0.01$$

RFT for Torsion :—

$$q = q_t - \frac{q_{ct}}{2} = \frac{Astr * Fy/\gamma s * 3 \alpha_t * XY}{s * b^2 * t}$$

$$\alpha_t = 0.66 + 0.33 * \frac{Y}{X}$$

$$Y = t - 5 = 55$$

$$X = b - 5 = 25$$

$$\alpha_t = 1.39$$

$$13.88 - \frac{9.58}{2} = \frac{Astr * 2400 * 3 * 1.39 * 55 * 25}{s * (30)^2 * 60 * 1.15}$$

$$\frac{As}{s} = 0.041$$

For Torsion & Shear :—

$$\frac{As}{s} = 0.01 + 0.041 = 0.051$$

try Φ 10 ⟶ s = 15.29

∴ use 7 Φ 10/m

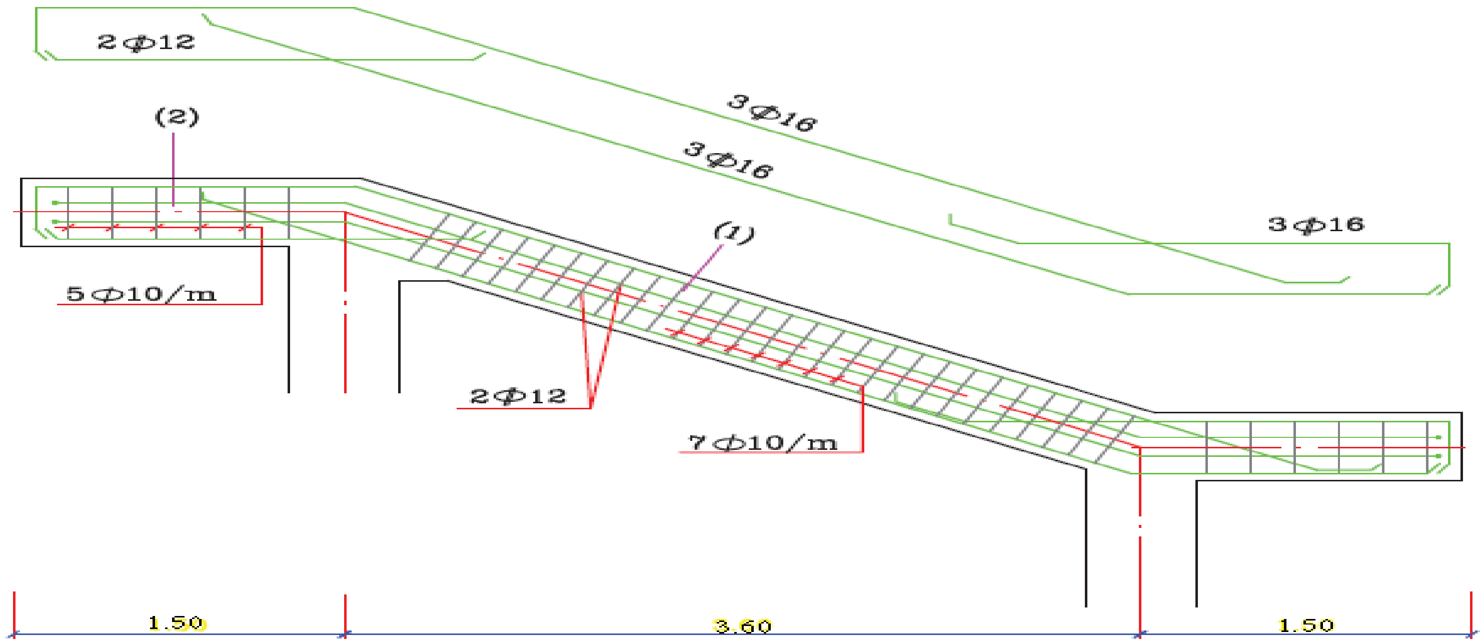
RFT for Longitudinal Steel :—

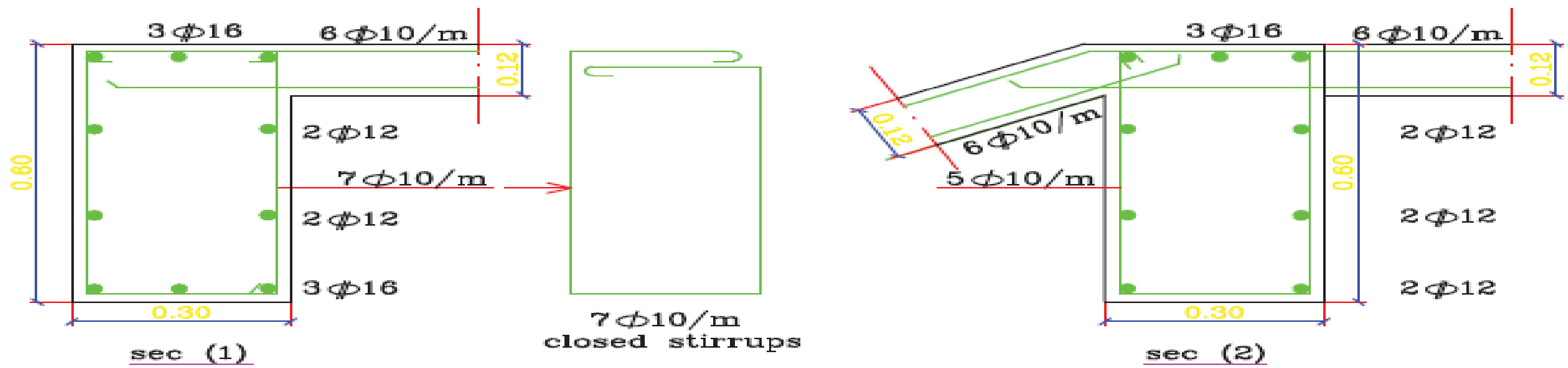
$$A_{SL} = [\, 2 * A_{str} * (X_1 + Y_1)/s \,] * \frac{F_{yst}}{F_y}$$

$$A_{str} = 0.041 * s = 0.041 * \frac{100}{7} = 0.586$$

$$= [\, 2 * (0.582) * (25 + 55)/14.3 \,] * \frac{2400}{3600}$$

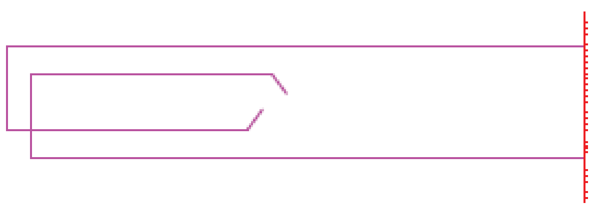
$$= 4.73 \text{ cm}^2 \quad 4 \Phi 12$$

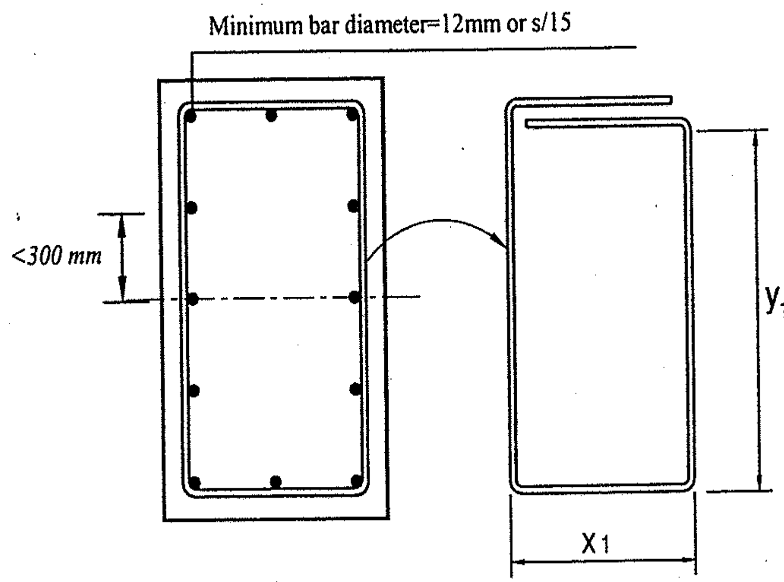

2 Φ12
3 Φ16
3 Φ16
3 Φ16
(2)
(1)
5 Φ10/m
2 Φ12
7 Φ10/m
1.50
3.60
1.50


3 Φ16
6 Φ10/m
0.12
0.60
2 Φ12
7 Φ10/m
2 Φ12
3 Φ16
0.30
sec (1)
7 Φ10/m
closed stirrups
3 Φ16
6 Φ10/m
0.12
0.12
6 Φ10/m
5 Φ10/m
0.60
2 Φ12
2 Φ12
2 Φ12
0.30
sec (2)

Notes:

- The Distance between Bars ≯ 300 mm
- RFT of torsion (transverse or extended) must be extended to distance ($X_1 + Y_1$) after the critical section





End of Longitudinal Bars