Cairo University

Faculty of Engineering

Structural Engineering Department

Design Aids For Reinforced Concrete Structures According to ECP-203-2018

Prepared by **Reinforced Concrete Staff Members**

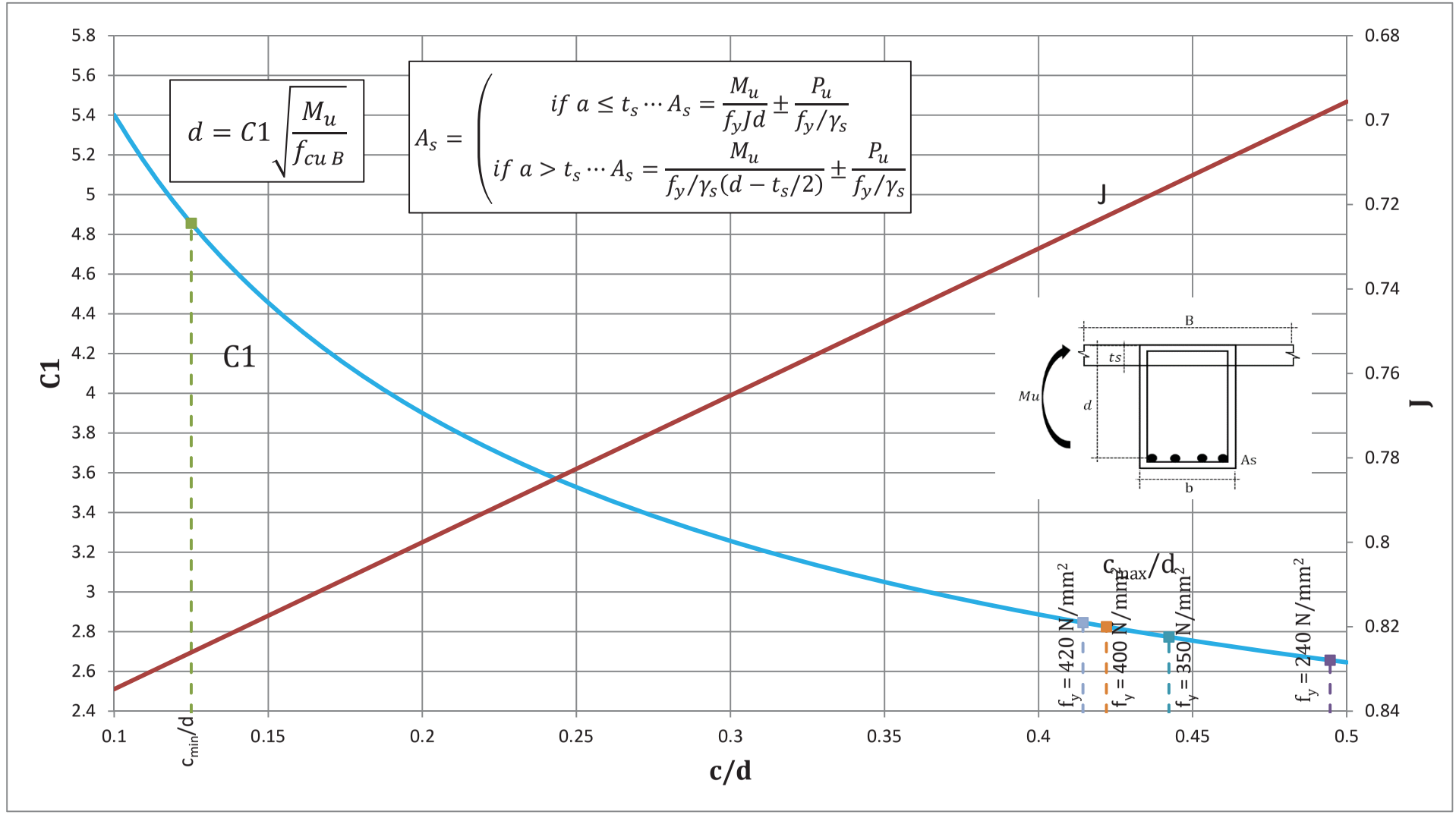
Area of Steel Reinforcement Used in Egypt

ϕ	Weight	Area of Cross Section in cm^2											
mm	(kg/m')	1	2	3	4	5	6	7	8	9	10	11	12
6	0.222	0.283	0.565	0.848	1.131	1.414	1.696	1.979	2.262	2.545	2.827	3.110	3.393
8	0.395	0.503	1.005	1.508	2.011	2.513	3.016	3.519	4.021	4.524	5.027	5.529	6.032
10	0.617	0.785	1.571	2.356	3.142	3.927	4.712	5.498	6.283	7.069	7.854	8.639	9.425
12	0.888	1.131	2.262	3.393	4.524	5.655	6.786	7.917	9.048	10.179	11.310	12.441	13.572
14	1.208	1.539	3.079	4.618	6.158	7.697	9.236	10.776	12.315	13.854	15.394	16.933	18.473
16	1.578	2.011	4.021	6.032	8.042	10.053	12.064	14.074	16.085	18.096	20.106	22.117	24.127
18	1.998	2.545	5.089	7.634	10.179	12.723	15.268	17.813	20.358	22.902	25.447	27.992	30.536
20	2.466	3.142	6.283	9.425	12.566	15.708	18.850	21.991	25.133	28.274	31.416	34.558	37.699
22	2.984	3.801	7.603	11.404	15.205	19.007	22.808	26.609	30.411	34.212	38.013	41.815	45.616
25	3.853	4.909	9.817	14.726	19.635	24.544	29.452	34.361	39.270	44.179	49.087	53.996	58.905
28	4.834	6.158	12.315	18.473	24.630	30.788	36.945	43.103	49.260	55.418	61.575	67.733	73.890
32	6.313	8.042	16.085	24.127	32.170	40.212	48.255	56.297	64.340	72.382	80.425	88.467	96.510

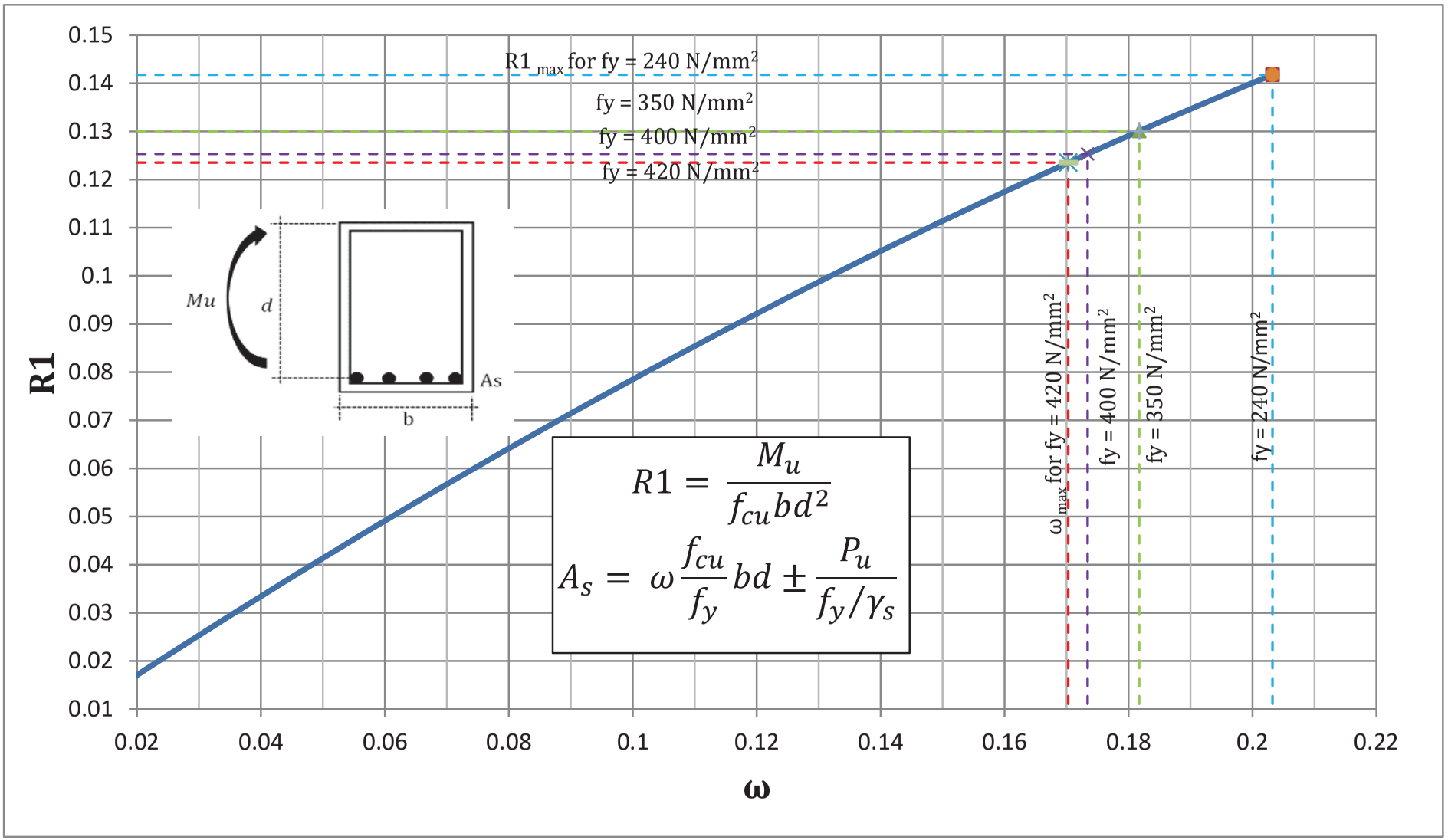
Design Chart For Sections Subjected To Simple Bending (R and T-sections)

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

$$A_s = \begin{cases} if\ a \le t_s \cdots A_s = \dfrac{M_u}{f_y J d} \pm \dfrac{P_u}{f_y/\gamma_s} \\ if\ a > t_s \cdots A_s = \dfrac{M_u}{f_y/\gamma_s (d - t_s/2)} \pm \dfrac{P_u}{f_y/\gamma_s} \end{cases}$$



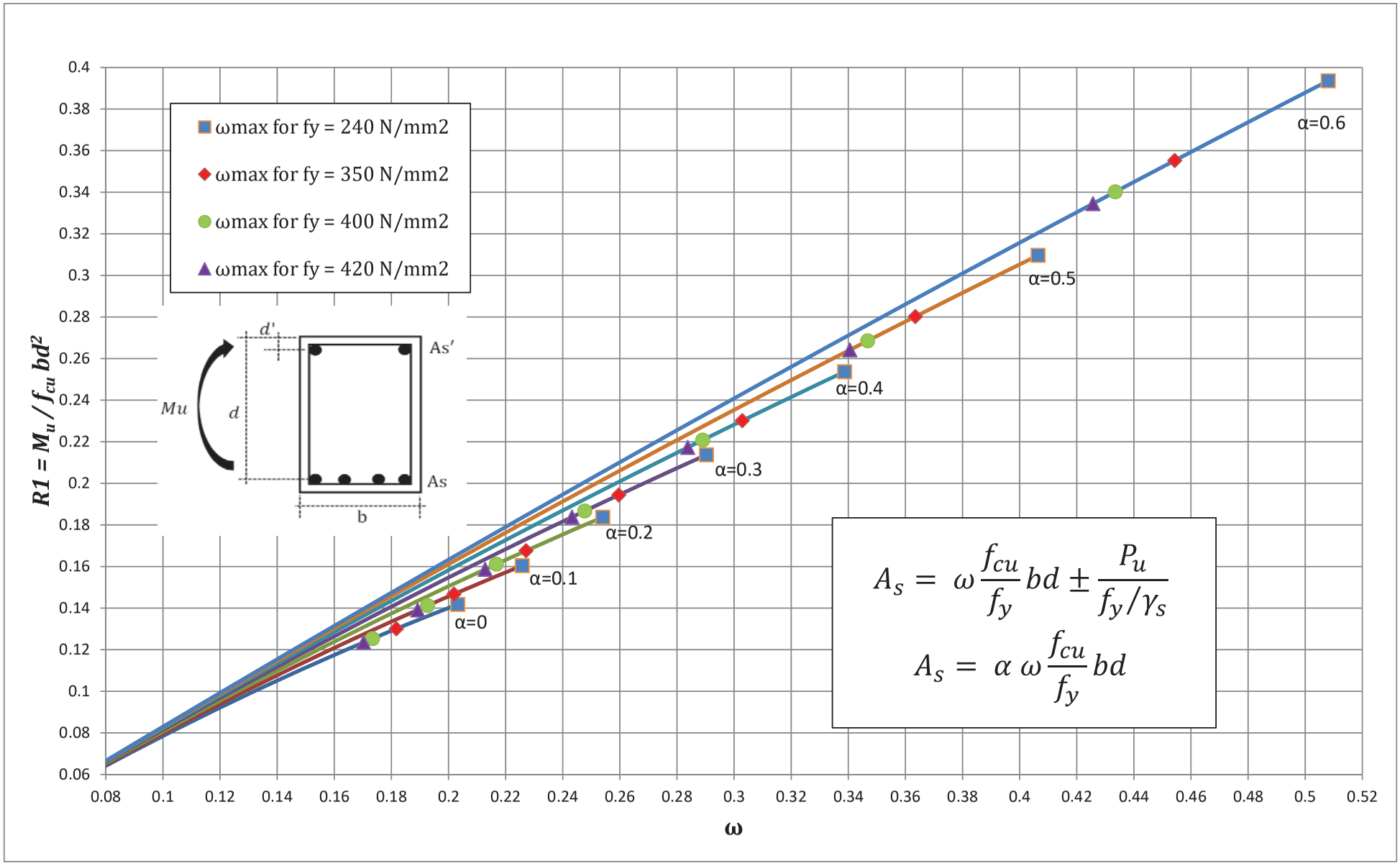
Design Chart For Sections Subjected To Simple Bending



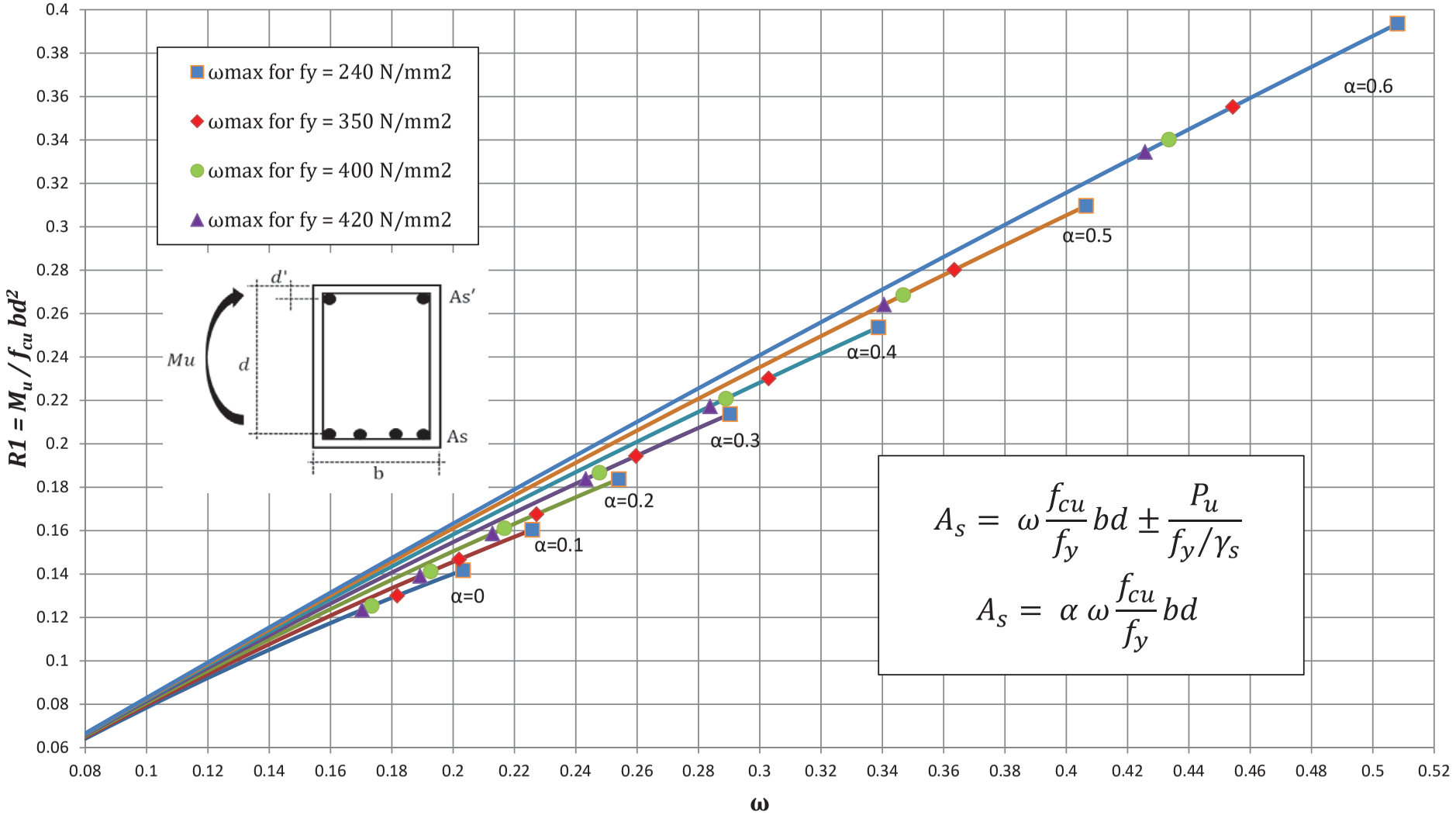
$$R1 = \frac{M_u}{f_{cu} b d^2}$$

$$A_s = \omega \frac{f_{cu}}{f_y} b d \pm \frac{P_u}{f_y / \gamma_s}$$

Design Chart For Doubly Reinforced Sections Subjected To Simple Bending (d'/d = 0.05)



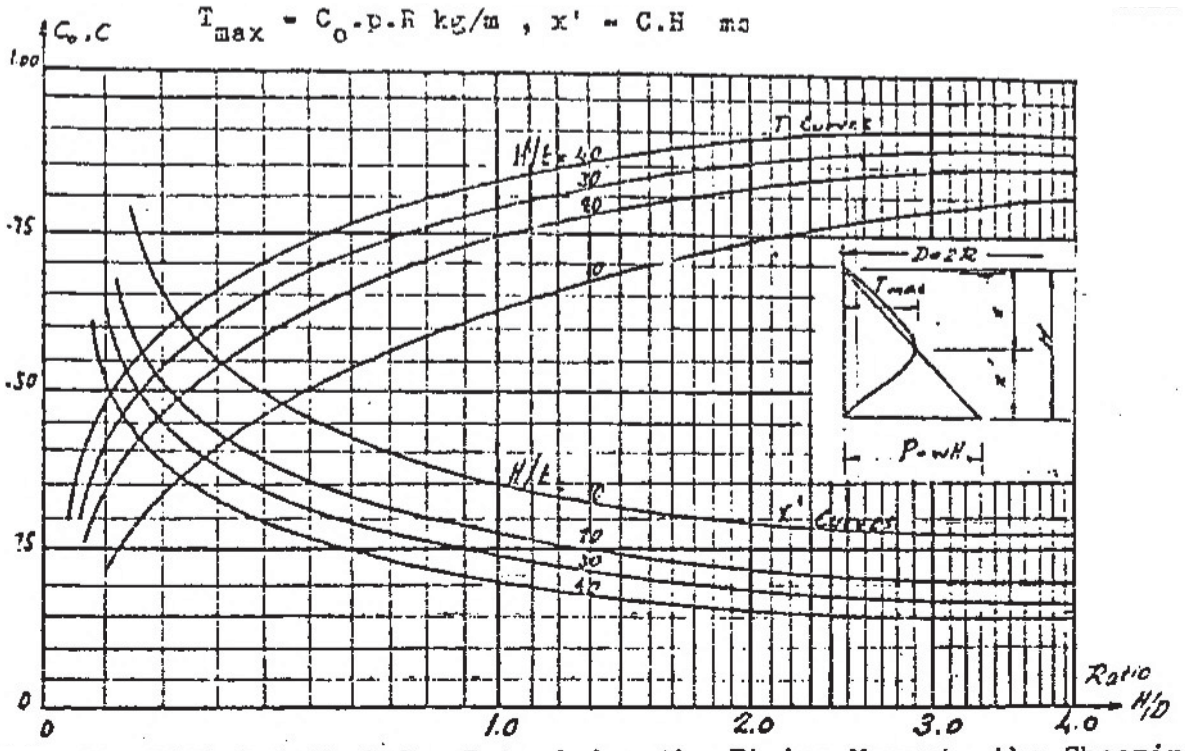
Design Chart For Doubly Reinforced Sections Subjected To Simple Bending (d'/d = 0.1)



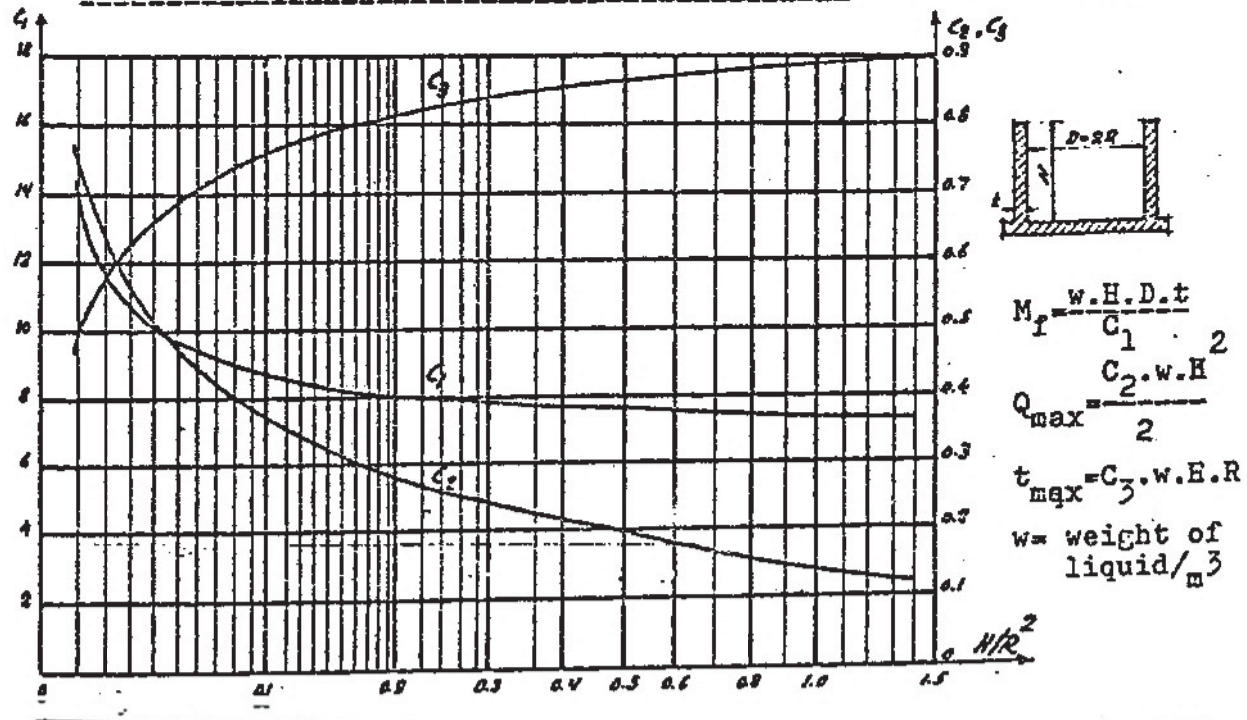
$$A_s = \omega \frac{f_{cu}}{f_y} bd \pm \frac{P_u}{f_y/\gamma_s}$$

$$A_s = \alpha\, \omega \frac{f_{cu}}{f_y} bd$$

* Values of Maximum Ring Tension and Its Position



Simplified Method for Detrmining the Fixing Moment, the Shearing Force and the Thickness of the Wall at Base (by Prof.Dr. M.Hilal)



$$M_f = \frac{w.H.D.t}{C_1}$$

$$Q_{max} = \frac{C_2.w.H^2}{2}$$

$$t_{max} = C_3.w.H.R$$

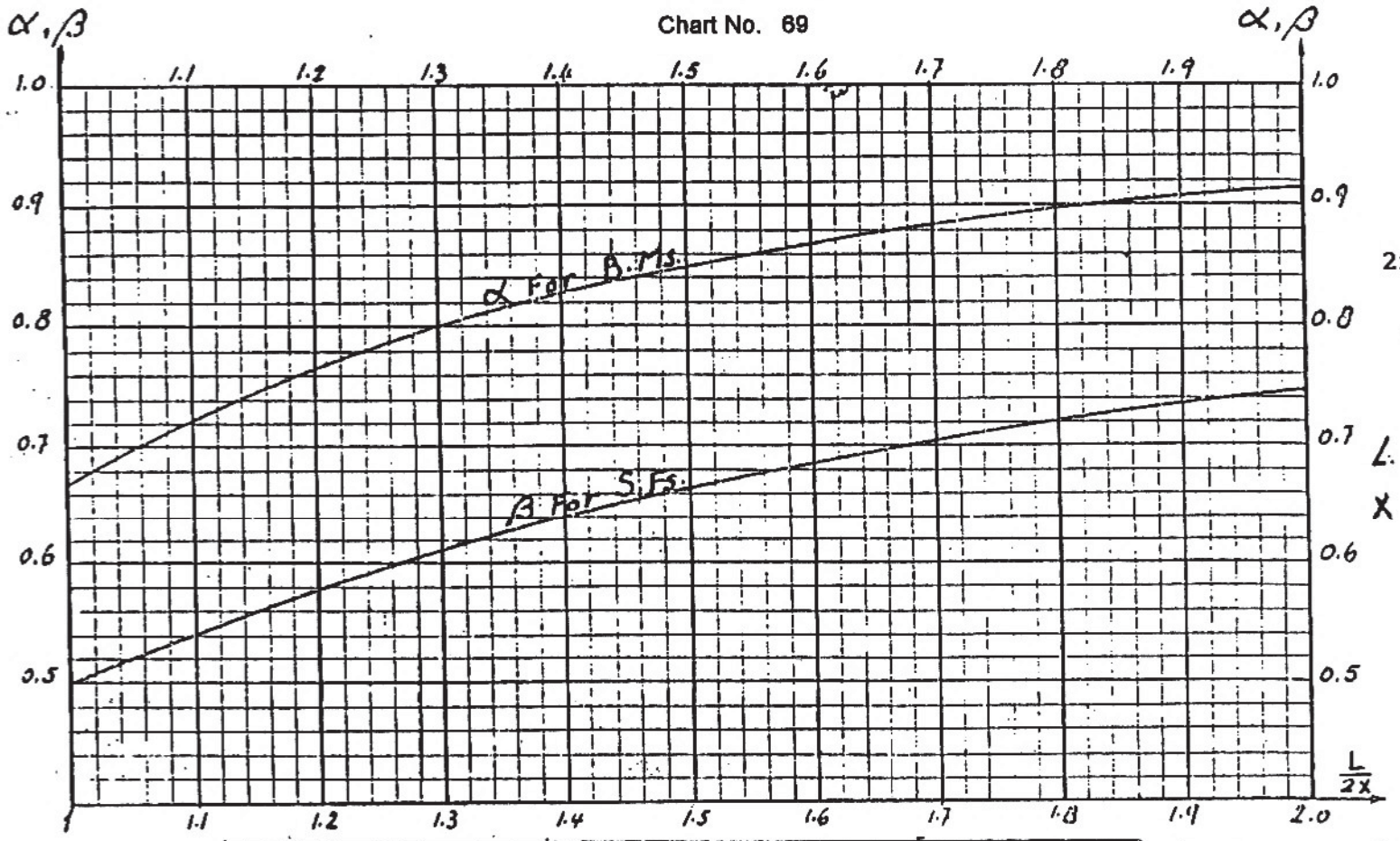
w= weight of liquid/m^3

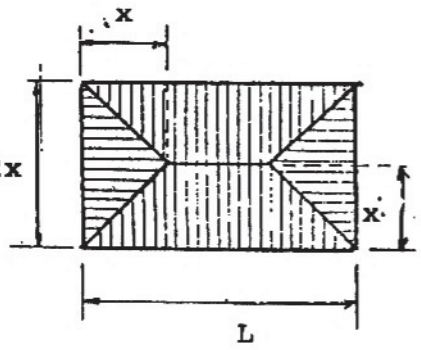
H/R^2	1.4	1.2	1.0	0.8	0.6	0.4	0.2	0.1	0.08	0.06	0.04	0.02	0.01
n	16.4	15.2	13.9	12.5	10.9	9.00	6.56	4.77	4.32	3.82	3.23	2.44	1.93
C_1	7.40	7.44	7.49	7.55	7.65	7.82	8.22	8.80	9.04	9.4	10.1	11.7	14.4
C_2	.118	.127	.128	.154	.175	.211	.284	.375	.409	.455	.525	.646	.763
C_3	.800	.895	.890	.802	.870	.852	.812	.756	.736	.708	.663	.570	.462

REINFORCED CONCRETE

Coefficients giving equivalent uniform loads on beams supporting two way slabs.

Chart No. 69





L = span of beam.
X = max. load breadth.

L/2x	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	.667	.725	.769	.803	.819	.853	.870	.885	.897	.908	.917
β	.500	.544	.582	.615	.642	.667	.688	.706	.722	.737	.750

load for calculating B.Ms. in beam = α.w.X

load for calculating S.Fs. in beam = β.w.X

α, β Values for solid slabs cast momlithically with beams.											
r	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	.35	.40	.45	.50	.55	.60	.65	.70	.75	.80	.85
β	.35	.29	.25	.21	.18	.16	.14	.12	.11	.09	.08

where : $\beta = 0.35 / r^1$ & $\alpha = 0.5\ r - 0.15$

α, β Values for slabs resting on masonary walls and for two way ribbed slabs with complete compersion flange. (Marcus)											
r	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	.396	.473	.543	.606	.660	.706	.746	.778	.806	.830	.849
β	.396	.333	.262	.212	.172	.140	.113	.093	.077	.063	.053

α, β Values for ribbed slab with non-complete compersion flange.(cover slab parrtially omitted (Grashoff)											
r	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
α	.500	.595	.672	.742	.797	.834	.867	.893	.914	.928	.941
β	.500	.405	.328	.258	.203	.166	.133	.107	.086	.072	.059

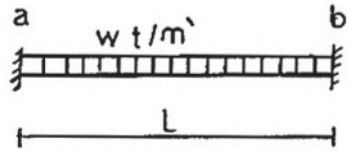
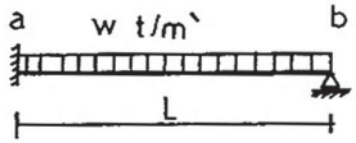
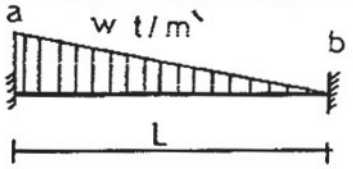
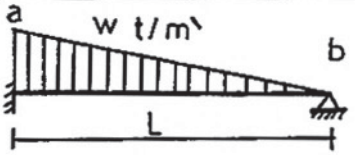
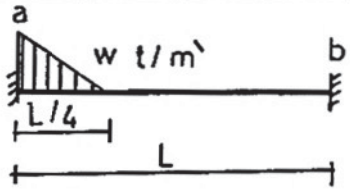
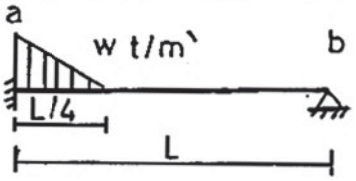
Materials required for Hollow block slabs

Dimensions of Blocks (cm)	Materials required/m^2				Dead loads kg/m^2			
	N° of Block		Concrete m^3		Leca Blocks		Conc. Blocks	
	1 way	2 way	1 way	2 way	1 way	2 way	1 way	2 way
15x20x50	10	8.4	.073	.089	238	270	300	320
15x20x40	10.4	8.7	.075	.096	240	284	303	336
20x20x40	10.4	8.7	.083	.111	265	330	330	380
25x20x40	10	8	.100	.140	320	406	410	478

Weight of brick & block walls (kg/m^2, with 2cm plaster on each side & mortar joint thickness = 1cm)

Type of unit		Dimensions (cm)	wall thick	Weight of mortar/m^2	Weight of wall/m^2
Solid Conc.blocks	بلوكات أسمنتية	25x12x10	12	34	300.6
Solid Conc.blocks		25x12x10	25	90.15	533.4
Hollow conc.blocks		40x20x12	12	14.5	244
Hollow conc.blocks		40x20x20	20	22	312
Solid Leca bricks	بلوكات ليكا أسمنتية	25x12x6	12	47.68	248
Solid Leca bricks		25x12x6	25	121.42	431
Hollow Leca blocks		50x20x12	12	18.13	180
Hollow Leca blocks		50x25x20	20	26.13	250
Hollow Leca blocks		50x25x20	25	37.81	294
Heavy solid Sand	بلوكات الطفل الرملي (الحجري)	25x12x6	12	47.68	316
Heavy solid Sand		25x12x6	25	121.42	568
light solid Sand		50x20x10	10	15.13	183
light solid Sand		60x20x12	12	14.71	198
light solid Sand		50x25x20	20	26.13	285
light solid Sand		50x25x25	25	37.82	337
Solid Shale bricks	الطفل الطيني	25x12x6	12	47.68	301
Perforated Shale		25x12x6	12	47.68	262
Perforated Shale		25x12x6	25	117.42	456
Gypsum blocks	الطين الجبسي	66.6x50x10	10	6	105
Gypsum blocks		33.3x50x8	8	6	78

Fixed End Moments And Elastic Reactions For Beams

Case	F.E.M		Elastic Reaction	
	M_a	M_b	Y_a	Y_b
	$\frac{W L^2}{12}$	$\frac{W L^2}{12}$	$\frac{W L^3}{24}$	$\frac{W L^3}{24}$
	$\frac{W L^2}{8}$	0	$\frac{W L^3}{24}$	$\frac{W L^3}{24}$
	$\frac{W L^2}{20}$	$\frac{W L^2}{30}$	$\frac{W L^3}{45}$	$\frac{W L^3}{51.5}$
	$\frac{W L^2}{15}$	0	$\frac{W L^3}{45}$	$\frac{W L^3}{51.5}$
	$\frac{W L^2}{72.5}$	$\frac{W L^2}{900}$	$\frac{W L^3}{350}$	$\frac{W L^3}{587}$
	$\frac{W L^2}{65}$	0	$\frac{W L^3}{350}$	$\frac{W L^3}{587}$