

**TABLE A.1****Designations, diameters, areas, and weights of standard bars**

Designation	Diameter mm	Area mm <sup>2</sup>	Perimeter mm	Nominal Weight kg/m
D 6	6.35	31.67	20	0.249
D10	9.53	71.33	30	0.560
D13	12.7	126.7	40	0.995
D16	15.9	198.6	50	1.56
D19	19.1	286.5	60	2.25
D22	22.2	387.1	70	3.04
D25	25.4	506.7	80	3.98
D29	28.6	642.4	90	5.04
D32	31.8	794.2	100	6.23
D35	34.9	956.6	110	7.51
D38	38.1	1,140	120	8.95
D41	41.3	1,340	130	10.5
D51	50.8	2,027	160	15.9

**TABLE A.2****Areas of groups of standard bars, mm<sup>2</sup>**

Bar No.	Number of Bars											
	1	2	3	4	5	6	7	8	9	10	11	12
D 6	31.67	63.34	95.01	126.7	158.4	19.00	221.7	253.4	285.0	316.7	348.4	380.0
D10	71.33	142.7	214.0	285.3	356.7	428.0	499.3	580.6	641.8	313.3	784.6	856.0
D13	126.7	253.4	380.1	506.8	633.5	760.2	886.9	1,014	1,140	1,267	1,394	1,520
D16	198.6	397.2	596.0	794.0	993.0	1,192	1,390	1,589	1,787	1,986	2,185	2,383
D19	286.5	573.0	860.0	1,146	1,433	1,719	2,006	2,292	2,579	2,865	3,156	3,438
D22	387.1	774.2	1,161	1,548	1,936	2,323	2,710	3,097	3,484	3,871	4,258	4,645
D25	506.7	1,013	1,520	2,027	2,534	3,040	3,547	4,054	4,560	5,067	5,574	6,080
D29	642.4	1,285	1,927	2,570	3,212	3,854	4,497	5,140	5,782	6,424	7,066	7,709
D32	794.2	1,522	2,383	3,177	3,971	4,765	5,559	6,354	7,148	7,942	8,736	9,530
D35	956.6	1,913	2,870	3,826	4,783	5,740	6,696	7,653	8,609	9,566	10,520	11,480
D38	1,140	2,280	3,420	4,560	5,700	6,840	7,980	9,120	10,260	11,400	12,540	13,680
D41	1,340	2,680	4,020	5,360	6,700	8,040	9,380	10,720	12,060	13,400	14,740	16,080
D51	2,027	4,054	6,081	8,108	10,140	12,160	14,190	16,220	18,240	20,270	22,200	24,320

**TABLE A.3****Areas of bars in slab, mm<sup>2</sup>/m**

Spacing mm	Bar No.						
	D10	D13	D16	D19	D22	D25	D29
100	713.3	1,267	1,986	2,865	3,871	5,067	6,424
125	570.6	1,014	1,589	2,292	3,097	4,054	5,139
150	475.5	844.7	1,324	1,910	2,581	3,378	4,283
175	407.6	724.0	1,350	1,637	2,212	2,895	3,671
200	356.7	633.5	993.0	1,436	1,936	2,534	3,212
225	310.7	563.1	882.7	1,273	1,720	2,252	2,855
250	285.3	506.8	794.4	1,146	1,548	2,027	2,579
275	259.4	460.7	722.2	1,042	1,408	1,843	2,336
300	237.8	422.3	662.0	955.0	1,290	1,689	2,141

**TABLE A.4****Limiting steel reinforcement ratio for singly reinforced rectangular beams**

$f_y$ MPa	$f_{ck}$ MPa	$\beta_1$	$\rho_b$	$\rho_{max} = 0.75\rho_b$	$\rho_{min} = \frac{0.25\sqrt{f_{ck}}}{f_y}$	$\rho_{min} = \frac{1.4}{f_y}$
300	21	0.85	0.0337	0.0253	0.0038	0.0047
	24	0.85	0.0385	0.0289	0.0041	0.0047
	27	0.85	0.0434	0.0325	0.0043	0.0047
	30	0.84	0.0474	0.0355	0.0046	0.0047
	35	0.80	0.0530	0.0397	0.0049	0.0047
	40	0.77	0.0579	0.0434	0.0053	0.0047
	400	21	0.85	0.0228	0.0171	0.0029
24		0.85	0.0260	0.0195	0.0031	0.0035
27		0.85	0.0293	0.0219	0.0032	0.0035
30		0.84	0.0320	0.0240	0.0034	0.0035
35		0.80	0.0357	0.0268	0.0037	0.0035
40		0.77	0.0391	0.0293	0.0040	0.0035

$$\rho_b = 0.85\beta_1 \frac{f_{ck}}{f_y} \times \frac{600}{600 + f_y}$$

**TABLE A.5a**

**Flexural resistance factor:**  $R = \rho f_y \left( 1 - 0.59 \times \frac{\rho f_y}{f_{ck}} \right)$  MPa

$\rho$	$f_y = 300$				$f_y = 400$			
	$f_{ck}$				$f_{ck}$			
	21	24	27	30	21	24	27	30
0.0005	0.15	0.15	0.15	0.15	0.20	0.20	0.20	0.20
0.0010	0.30	0.30	0.30	0.30	0.40	0.40	0.40	0.40
0.0015	0.44	0.45	0.45	0.45	0.59	0.59	0.59	0.59
0.0020	0.59	0.59	0.59	0.59	0.78	0.78	0.79	0.79
0.0025	0.73	0.74	0.74	0.74	0.97	0.98	0.98	0.98
0.0030	0.88	0.88	0.88	0.88	1.16	1.16	1.17	1.17
0.0035	1.02	1.02	1.03	1.03	1.34	1.35	1.36	1.36
0.0040	1.16	1.16	1.17	1.17	1.53	1.54	1.54	1.55
0.0045	1.30	1.31	1.31	1.31	1.71	1.72	1.73	1.74
0.0050	1.44	1.44	1.45	1.46	1.89	1.90	1.91	1.92
0.0055	1.57	1.58	1.59	1.60	2.06	2.08	2.09	2.10
0.0060	1.71	1.72	1.73	1.74	2.24	2.26	2.27	2.29
0.0065	1.84	1.86	1.87	1.88	2.41	2.43	2.45	2.47
0.0070	1.98	1.99	2.00	2.01	2.58	2.61	2.63	2.65
0.0075	2.11	2.13	2.14	2.15	2.75	2.78	2.80	2.82
0.0080	2.24	2.26	2.27	2.29	2.91	2.95	2.98	3.00
0.0085	2.37	2.39	2.41	2.42	3.08	3.12	3.15	3.17
0.0090	2.50	2.52	2.54	2.56	3.24	3.28	3.32	3.35
0.0095	2.62	2.65	2.67	2.69	3.39	3.45	3.48	3.52
0.0100	2.75	2.78	2.80	2.82	3.55	3.61	3.65	3.69
0.0105	2.87	2.91	2.93	2.95	3.70	3.77	3.81	3.85
0.0110	2.99	3.03	3.06	3.09	3.86	3.92	3.98	4.02
0.0115	3.12	3.16	3.19	3.22	4.01	4.08	4.14	4.18
0.0120	3.24	3.28	3.32	3.35	4.15	4.23	4.30	4.35
0.0125	3.35	3.40	3.44	3.47	4.30	4.39	4.45	4.51
0.0130	3.47	3.53	3.57	3.60	4.44	4.54	4.61	4.67
0.0135	3.59	3.65	3.69	3.73	4.58	4.68	4.76	4.83
0.0140	3.70	3.77	3.81	3.85	4.72	4.83	4.91	4.98
0.0145	3.82	3.88	3.94	3.98	4.85	4.97	5.06	5.14



**TABLE A.6 Parameter k and j for elastic, cracked section beam analysis,**

where  $k = \sqrt{2\rho n + (\rho n)^2} - \rho n$ ;  $j = 1 - (1/3) \times k$

$\rho$	$n=7$		$n=8$		$n=9$		$n=10$	
	$k$	$j$	$k$	$j$	$k$	$j$	$k$	$j$
0.0010	0.112	0.963	0.119	0.960	0.125	0.958	0.132	0.956
0.0020	0.154	0.949	0.164	0.945	0.173	0.942	0.180	0.940
0.0030	0.185	0.938	0.196	0.935	0.207	0.931	0.217	0.928
0.0040	0.210	0.930	0.223	0.926	0.235	0.922	0.246	0.918
0.0050	0.232	0.923	0.246	0.918	0.258	0.914	0.270	0.910
0.0054	0.240	0.920	0.254	0.915	0.267	0.911	0.279	0.907
0.0058	0.247	0.918	0.262	0.913	0.275	0.908	0.287	0.904
0.0062	0.254	0.915	0.269	0.910	0.283	0.906	0.296	0.901
0.0066	0.261	0.913	0.276	0.908	0.290	0.903	0.303	0.899
0.0070	0.268	0.911	0.283	0.906	0.298	0.901	0.311	0.896
0.0072	0.271	0.910	0.287	0.904	0.301	0.900	0.314	0.895
0.0074	0.274	0.909	0.290	0.903	0.304	0.899	0.318	0.894
0.0076	0.277	0.908	0.293	0.902	0.308	0.897	0.321	0.893
0.0078	0.280	0.907	0.296	0.901	0.311	0.896	0.325	0.892
0.0080	0.283	0.906	0.299	0.900	0.314	0.895	0.328	0.891
0.0082	0.286	0.905	0.303	0.899	0.317	0.894	0.331	0.890
0.0084	0.289	0.904	0.306	0.898	0.321	0.893	0.334	0.889
0.0086	0.292	0.903	0.308	0.897	0.324	0.892	0.338	0.887
0.0088	0.295	0.902	0.311	0.896	0.327	0.891	0.341	0.886
0.0090	0.298	0.901	0.314	0.895	0.330	0.890	0.344	0.885
0.0092	0.300	0.900	0.317	0.894	0.332	0.889	0.347	0.884
0.0094	0.303	0.899	0.320	0.893	0.335	0.888	0.350	0.883
0.0096	0.306	0.898	0.323	0.892	0.338	0.887	0.353	0.882
0.0098	0.308	0.897	0.325	0.892	0.341	0.886	0.355	0.882
0.0100	0.311	0.896	0.328	0.891	0.344	0.885	0.358	0.881
0.0104	0.316	0.895	0.333	0.889	0.349	0.884	0.364	0.879
0.0108	0.321	0.893	0.338	0.887	0.354	0.882	0.369	0.877
0.0112	0.325	0.892	0.343	0.886	0.359	0.880	0.374	0.875
0.0116	0.330	0.890	0.348	0.884	0.364	0.879	0.379	0.874
0.0120	0.334	0.889	0.353	0.882	0.369	0.877	0.384	0.872
0.0124	0.339	0.887	0.357	0.881	0.374	0.875	0.389	0.870
0.0128	0.343	0.886	0.362	0.879	0.378	0.874	0.394	0.867
0.0132	0.347	0.884	0.366	0.878	0.383	0.872	0.398	0.867
0.0136	0.351	0.883	0.370	0.877	0.387	0.871	0.403	0.866
0.0140	0.355	0.882	0.374	0.875	0.392	0.869	0.407	0.864
0.0144	0.359	0.880	0.378	0.874	0.396	0.868	0.412	0.863
0.0148	0.363	0.879	0.382	0.873	0.400	0.867	0.416	0.861
0.0152	0.367	0.878	0.386	0.871	0.404	0.865	0.420	0.860
0.0156	0.371	0.876	0.390	0.870	0.408	0.864	0.424	0.859
0.0160	0.374	0.875	0.394	0.869	0.412	0.863	0.428	0.857
0.0170	0.383	0.872	0.403	0.867	0.421	0.860	0.437	0.854
0.0180	0.392	0.869	0.412	0.863	0.430	0.857	0.446	0.851
0.0190	0.400	0.867	0.420	0.860	0.438	0.854	0.455	0.848
0.0200	0.407	0.864	0.428	0.857	0.446	0.851	0.463	0.846

**TABLE A.7****Minimum width of beam for a single layer of tensile bars, mm**

<b>D13 Stirrups</b>									
<b>Bar No.</b>	<b>Number of Bars</b>								
	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>
D13	290	330	370	410	450	500	530	580	620
D19	300	350	390	440	480	530	570	610	650
D22	320	370	410	460	510	560	600	650	700
D25	340	390	440	490	540	600	640	690	740
D29	370	420	480	540	600	650	710	770	820
D32	400	460	520	580	650	710	780	840	
D35	420	490	560	630	700	770	870		
D38	450	520	600	680	760	840			

  

<b>D16 Stirrups</b>									
<b>Bar No.</b>	<b>Number of Bars</b>								
	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>13</b>
D19	310	360	400	440	490	530	580	620	660
D22	330	370	420	470	520	560	610	660	700
D25	340	400	450	500	550	600	650	700	750
D29	370	430	490	540	600	660	720	770	830
D32	400	470	530	590	660	720	780	850	
D35	430	500	570	640	710	780	850		
D38	460	530	610	690	760	840			
D41	490	570	650	740	820				

Minimum spacing of rebars is 25 mm

Minimum concrete cover is 40 mm