APPENDIX A

Design Aids

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

Bar No.				
SI[a]	Inch-Pound[b]	Diameter, mm	Cross-Sectional Area, mm^2	Nominal Mass, kg/m
10	3	9.5	71	0.560
13	4	12.7	129	0.994
16	5	15.9	199	1.552
19	6	19.1	284	2.235
22	7	22.2	387	3.042
25	8	25.4	510	3.973
29	9	28.7	645	5.060
32	10	32.3	819	6.404
36	11	35.8	1,006	7.907
43	14	43.0	1,452	11.380
57	18	57.3	2,581	20.240

[a] Bar number approximates the number of millimeters included in the nominal diameter of the bar. Bars are marked with this designation. The nominal diameter of a deformed bar is equivalent to the diameter of a plain bar having the same mass per unit length as the deformed bar.

[b] Based on the number of eighths of an inch included in the nominal diameter of the bars.

TABLE A.2
Areas of groups of bars, mm^2

Bar No.		Number of Bars											
SI	Inch-Pound	1	2	3	4	5	6	7	8	9	10	11	12
10	3	71	142	213	284	355	426	497	568	639	710	781	852
13	4	129	258	387	516	645	774	903	1,032	1,161	1,290	1,419	1,548
16	5	199	398	597	796	995	1,194	1,393	1,592	1,791	1,990	2,189	2,388
19	6	284	568	852	1,136	1,420	1,704	1,988	2,272	2,556	2,840	3,124	3,408
22	7	387	774	1,161	1,548	1,935	2,322	2,709	3,096	3,483	3,870	4,257	4,644
25	8	510	1,020	1,530	2,040	2,550	3,060	3,570	4,080	4,590	5,100	5,610	6,120
29	9	645	1,290	1,935	2,580	3,225	3,870	4,515	5,160	5,805	6,450	7,095	7,740
32	10	819	1,638	2,457	3,276	4,095	4,914	5,733	6,552	7,371	8,190	9,009	9,828
36	11	1,006	2,012	3,018	4,024	5,030	6,036	7,042	8,048	9,054	10,060	11,066	12,072
43	14	1,452	2,904	4,356	5,808	7,260	8,712	10,164	11,616	13,068	14,520	15,972	17,424
57	18	2,581	5,162	7,743	10,324	12,905	15,486	18,067	20,648	23,229	25,810	28,391	30,972

TABLE A.3
Areas of bars in slabs, mm^2/m

		Bar No.								
Spacing,	SI:	10	13	16	19	22	25	29	32	36
mm	Inch-Pound:	3	4	5	6	7	8	9	10	11
75		947	1,720	2,653	3,787	5,160	6,800	8,600	10,920	13,413
80		888	1,613	2,488	3,550	4,838	6,375	8,063	10,238	12,575
90		789	1,433	2,211	3,156	4,300	5,667	7,167	9,100	11,178
100		710	1,290	1,990	2,840	3,870	5,100	6,450	8,190	10,060
110		645	1,173	1,809	2,582	3,518	4,636	5,864	7,445	9,145
120		592	1,075	1,658	2,367	3,225	4,250	5,375	6,825	8,383
130		546	992	1,531	2,185	2,977	3,923	4,962	6,300	7,738
140		507	921	1,421	2,029	2,764	3,643	4,607	5,850	7,186
150		473	860	1,327	1,893	2,580	3,400	4,300	5,460	6,707
160		444	806	1,244	1,775	2,419	3,188	4,031	5,119	6,288
170		418	759	1,171	1,671	2,276	3,000	3,794	4,818	5,918
180		394	717	1,106	1,578	2,150	2,833	3,583	4,550	5,589
190		374	679	1,047	1,495	2,037	2,684	3,395	4,311	5,295
200		355	645	995	1,420	1,935	2,550	3,225	4,095	5,030
225		316	573	884	1,262	1,720	2,267	2,867	3,640	4,471
250		284	516	796	1,136	1,548	2,040	2,580	3,276	4,024
300		237	430	663	947	1,290	1,700	2,150	2,730	3,353

TABLE A.4
Limiting steel reinforcement ratios for tension-controlled members

f_y, MPa	f'_c, MPa	β_1	$\rho_{0.005}$[a] $\epsilon_t = 0.005$[b]	$\rho_{0.004}$[a] $\epsilon_t = 0.004$[c]	$\rho_{\min} = \frac{1.4}{f_y}$	$\rho_{\min} = \frac{0.25\sqrt{f'_c}}{f_y}$
280	21	0.850	0.0203	0.0232	0.0050	0.0041
	28	0.850	0.0271	0.0310	0.0050	0.0047
	35	0.800	0.0319	0.0364	0.0050	0.0053
	42	0.750	0.0359	0.0410	0.0050	0.0058
	49	0.700	0.0390	0.0446	0.0050	0.0063
	56	0.650	0.0414	0.0474	0.0050	0.0067
	63	0.650	0.0466	0.0533	0.0050	0.0071
	70	0.650	0.0518	0.0592	0.0050	0.0075
350	21	0.850	0.0163	0.0186	0.0040	0.0033
	28	0.850	0.0217	0.0248	0.0040	0.0038
	35	0.800	0.0255	0.0291	0.0040	0.0042
	42	0.750	0.0287	0.0328	0.0040	0.0046
	49	0.700	0.0312	0.0357	0.0040	0.0050
	56	0.650	0.0332	0.0379	0.0040	0.0053
	63	0.650	0.0373	0.0426	0.0040	0.0057
	70	0.650	0.0414	0.0474	0.0040	0.0060
420	21	0.850	0.0135	0.0155	0.0033	0.0027
	28	0.850	0.0181	0.0206	0.0033	0.0031
	35	0.800	0.0213	0.0243	0.0033	0.0035
	42	0.750	0.0239	0.0273	0.0033	0.0039
	49	0.700	0.0260	0.0298	0.0033	0.0042
	56	0.650	0.0276	0.0316	0.0033	0.0045
	63	0.650	0.0311	0.0355	0.0033	0.0047
	70	0.650	0.0345	0.0395	0.0033	0.0050
520	21	0.850	0.0109	0.0125	0.0027	0.0022
	28	0.850	0.0146	0.0167	0.0027	0.0025
	35	0.800	0.0172	0.0196	0.0027	0.0028
	42	0.750	0.0193	0.0221	0.0027	0.0031
	49	0.700	0.0210	0.0240	0.0027	0.0034
	56	0.650	0.0223	0.0255	0.0027	0.0036
	63	0.650	0.0251	0.0287	0.0027	0.0038
	70	0.650	0.0279	0.0319	0.0027	0.0040

[a] $\rho = 0.85\beta_1 \frac{f'_c}{f_y} \frac{0.003}{0.003 + \epsilon_t}$

[b] $\frac{c}{d_t} = 0.375, \frac{a}{d_t} = 0.375\beta_1$

[c] $\frac{c}{d_t} = 0.429, \frac{a}{d_t} = 0.429\beta_1$

TABLE A.5a
Flexural resistance factor: $R = \rho f_y\left(1 - 0.588\,\frac{\rho f_y}{f'_c}\right)$ MPa

	f_y = 280 MPa					f_y = 420 MPa				
	f'_c, MPa					f'_c, MPa				
ρ	21	28	35	42	49	21	28	35	42	49
0.0005	0.14	0.14	0.14	0.14	0.14	0.21	0.21	0.21	0.21	0.21
0.0010	0.28	0.28	0.28	0.28	0.28	0.42	0.42	0.42	0.42	0.42
0.0015	0.42	0.42	0.42	0.42	0.42	0.62	0.62	0.62	0.62	0.63
0.0020	0.55	0.55	0.55	0.56	0.56	0.82	0.83	0.83	0.83	0.83
0.0025	0.69	0.69	0.69	0.69	0.69	1.02	1.03	1.03	1.03	1.04
0.0030	0.82	0.83	0.83	0.83	0.83	1.22	1.23	1.23	1.24	1.24
0.0035	0.95	0.96	0.96	0.97	0.97	1.41	1.42	1.43	1.44	1.44
0.0040	1.08	1.09	1.10	1.10	1.10	1.60	1.62	1.63	1.64	1.65
0.0045	1.22	1.23	1.23	1.24	1.24	1.79	1.81	1.83	1.84	1.85
0.0050	1.35	1.36	1.37	1.37	1.38	1.98	2.01	2.03	2.04	2.05
0.0055	1.47	1.49	1.50	1.51	1.51	2.16	2.20	2.22	2.24	2.25
0.0060	1.60	1.62	1.63	1.64	1.65	2.34	2.39	2.41	2.43	2.44
0.0065	1.73	1.75	1.76	1.77	1.78	2.52	2.57	2.60	2.63	2.64
0.0070	1.85	1.88	1.90	1.91	1.91	2.70	2.76	2.79	2.82	2.84
0.0075	1.98	2.01	2.03	2.04	2.05	2.87	2.94	2.98	3.01	3.03
0.0080	2.10	2.13	2.16	2.17	2.18	3.04	3.12	3.17	3.20	3.22
0.0085	2.22	2.26	2.28	2.30	2.31	3.21	3.30	3.36	3.39	3.42
0.0090	2.34	2.39	2.41	2.43	2.44	3.38	3.48	3.54	3.58	3.61
0.0095	2.46	2.51	2.54	2.56	2.58	3.54	3.66	3.72	3.77	3.80
0.0100	2.58	2.64	2.67	2.69	2.71	3.71	3.83	3.90	3.95	3.99
0.0105	2.70	2.76	2.79	2.82	2.84	3.87	4.00	4.08	4.14	4.18
0.0110	2.81	2.88	2.92	2.95	2.97	4.02	4.17	4.26	4.32	4.36
0.0115	2.93	3.00	3.05	3.07	3.10	4.18	4.34	4.44	4.50	4.55
0.0120	3.04	3.12	3.17	3.20	3.22	4.33	4.51	4.61	4.68	4.74
0.0125	3.16	3.24	3.29	3.33	3.35	4.48	4.67	4.79	4.86	4.92
0.0130	3.27	3.36	3.42	3.45	3.48	4.63	4.83	4.96	5.04	5.10
0.0135	3.38	3.48	3.54	3.58	3.61	4.77	4.99	5.13	5.22	5.28
0.0140	3.49	3.60	3.66	3.70	3.74	4.91	5.15	5.30	5.40	5.47
0.0145	3.60	3.71	3.78	3.83	3.86	5.05	5.31	5.47	5.57	5.64
0.0150	3.71	3.83	3.90	3.95	3.99	5.19	5.47	5.63	5.74	5.82
0.0155	3.81	3.94	4.02	4.08	4.11	5.32	5.62	5.80	5.92	6.00
0.0160	3.92	4.06	4.14	4.20	4.24		5.77	5.96	6.09	6.18
0.0165	4.02	4.17	4.26	4.32	4.36		5.92	6.12	6.26	6.35
0.0170	4.13	4.28	4.38	4.44	4.49		6.07	6.28	6.43	6.53
0.0175	4.23	4.40	4.50	4.56	4.61		6.22	6.44	6.59	6.70
0.0180	4.33	4.51	4.61	4.68	4.74		6.36	6.60	6.76	6.87
0.0185	4.43	4.62	4.73	4.80	4.86		6.50	6.76	6.92	7.05
0.0190	4.53	4.73	4.84	4.92	4.98		6.64	6.91	7.09	7.22
0.0195	4.63	4.83	4.96	5.04	5.10		6.78	7.06	7.25	7.39
0.0200	4.72	4.94	5.07	5.16	5.22		6.92	7.21	7.41	7.55

TABLE A.5b
Flexural resistance factor: $R = \rho f_y\left(1 - 0.588\frac{\rho f_y}{f'_c}\right)$MPa

	f_y = 280 MPa					f_y = 420 MPa				
	f'_c, MPa					f'_c, MPa				
ρ	21	28	35	42	49	21	28	35	42	49
0.003	0.82	0.83	0.83	0.83	0.83	1.22	1.23	1.23	1.24	1.24
0.004	1.08	1.09	1.10	1.10	1.10	1.60	1.62	1.63	1.64	1.65
0.005	1.35	1.36	1.37	1.37	1.38	1.98	2.01	2.03	2.04	2.05
0.006	1.60	1.62	1.63	1.64	1.65	2.34	2.39	2.41	2.43	2.44
0.007	1.85	1.88	1.90	1.91	1.91	2.70	2.76	2.79	2.82	2.84
0.008	2.10	2.13	2.16	2.17	2.18	3.04	3.12	3.17	3.20	3.22
0.009	2.34	2.39	2.41	2.43	2.44	3.38	3.48	3.54	3.58	3.61
0.010	2.58	2.64	2.67	2.69	2.71	3.71	3.83	3.90	3.95	3.99
0.011	2.81	2.88	2.92	2.95	2.97	4.02	4.17	4.26	4.32	4.36
0.012	3.04	3.12	3.17	3.20	3.22	4.33	4.51	4.61	4.68	4.74
0.013	3.27	3.36	3.42	3.45	3.48	4.63	4.83	4.96	5.04	5.10
0.014	3.49	3.60	3.66	3.70	3.74	4.91	5.15	5.30	5.40	5.47
0.015	3.71	3.83	3.90	3.95	3.99	5.19	5.47	5.63	5.74	5.82
0.016	3.92	4.06	4.14	4.20	4.24	5.46	5.77	5.96	6.09	6.18
0.017	4.13	4.28	4.38	4.44	4.49		6.07	6.28	6.43	6.53
0.018	4.33	4.51	4.61	4.68	4.74		6.36	6.60	6.76	6.87
0.019	4.53	4.73	4.84	4.92	4.98		6.64	6.91	7.09	7.22
0.020	4.72	4.94	5.07	5.16	5.22		6.92	7.21	7.41	7.55
0.021	4.91	5.15	5.30	5.40	5.47		7.19	7.51	7.73	7.89
0.022	5.10	5.36	5.52	5.63	5.70			7.81	8.04	8.22
0.023	5.28	5.57	5.74	5.86	5.94			8.09	8.35	8.54
0.024	5.46	5.77	5.96	6.09	6.18			8.37	8.66	8.86
0.025		5.97	6.18	6.31	6.41			8.65	8.96	9.18
0.026		6.17	6.39	6.54	6.64				9.25	9.49
0.027		6.36	6.60	6.76	6.87				9.54	9.80
0.028		6.55	6.81	6.98	7.10				9.82	10.10
0.029		6.74	7.01	7.20	7.33					10.40
0.030		6.92	7.21	7.41	7.55					10.69
0.031		7.10	7.41	7.63	7.78					
0.032			7.61	7.84	8.00					
0.033			7.81	8.04	8.22					
0.034			8.00	8.25	8.43					
0.035			8.19	8.46	8.65					
0.036			8.37	8.66	8.86					
0.037			8.56	8.86	9.07					
0.038				9.06	9.28					
0.039				9.25	9.49					
0.040				9.44	9.69					
0.041				9.63	9.90					

TABLE A.6

Parameters k and j for elastic, cracked section beam analysis, where $k = \sqrt{2\rho n + (\rho n)^2} - \rho n; j = 1 - \frac{1}{3}k$

	$n = 7$		$n = 8$		$n = 9$		$n = 10$	
ρ	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
Maximum number of bars as a single layer in beam stems

19 mm Maximum Aggregate Size, No. 13 (No. 4) Stirrups[a]

Bar No.		Beam Width b_w, mm											
SI	Inch-Pound	200	250	300	350	400	450	500	550	600	650	700	750
16	5	2	4	5	6	7	9	10	11	12	13	15	16
19	6	2	3	4	6	7	8	9	10	11	12	14	15
22	7	2	3	4	5	6	7	8	9	11	12	13	14
25	8	2	3	4	5	6	7	8	9	10	11	12	13
29	9	2	3	3	4	5	6	7	8	9	9	10	11
32	10	1	2	3	4	5	5	6	7	8	8	9	10
36	11	1	2	3	3	4	5	6	6	7	8	8	9
43	14	1	2	2	3	3	4	5	5	6	6	7	7
57	18	1	1	2	2	3	3	3	4	4	5	5	6

25 mm Maximum Aggregate Size, No. 13 (No. 4) Stirrups[a]

Bar No.		Beam Width b_w, mm											
SI	Inch-Pound	200	250	300	350	400	450	500	550	600	650	700	750
16	5	2	3	4	5	6	7	8	9	10	11	12	13
19	6	2	3	4	5	6	7	8	9	10	11	11	12
22	7	2	3	4	5	5	6	7	8	9	10	11	12
25	8	2	3	3	4	5	6	7	8	8	9	10	11
29	9	2	2	3	4	5	6	6	7	8	9	10	10
32	10	1	2	3	4	4	5	6	7	8	8	9	10
36	11	1	2	3	3	4	5	6	6	7	8	8	9

[a] Minimum concrete cover assumed to be 40 mm to the No. 13 (No. 4) stirrup.

TABLE A.8
Minimum number of bars as a single layer in beam stems governed by crack control requirements of the ACI Code

(*a*) 50 mm clear cover, sides and bottom

Minimum Number of Bars as a Single Layer of a Beam Stem

Bar No.		Beam Stem Width b_w, mm														
SI	**Inch-Pound**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**	**650**	**700**	**750**	**800**	**850**	**900**
10–43	3–14	1	1	2	2	3	3	3	3	3	4	4	4	4	4	5
57	18	1	1	2	2	2	3	3	3	3	3	4	4	4	4	4

(*b*) 40 mm clear cover, sides and bottom

Minimum Number of Bars as a Single Layer of a Beam Stem

Bar No.		Beam Stem Width b_w, mm														
SI	**Inch-Pound**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**550**	**600**	**650**	**700**	**750**	**800**	**850**	**900**
10–13	3–14	1	1	2	2	3	3	3	3	3	4	4	4	4	4	4
16–43	5–14	1	1	2	2	3	3	3	3	3	3	4	4	4	4	4
57	18	1	1	2	2	2	3	3	3	3	3	4	4	4	4	4

TABLE A.9

Design strength ϕM_n for slab sections 1 m wide, kN-m; $f_y = 420$ MPa; $\phi M_n = \phi f_y b d^2(1 - 0.59\rho f_y/f'_c)$

		Effective Depth *d*, mm									
f'_c, MPa	ρ	75	100	125	150	175	200	225	250	275	300
21	0.002	4.2	7.4	11.5	16.6	22.6	29.5	37.4	46.1	55.8	66.4
	0.003	6.2	10.9	17.1	24.6	33.5	43.8	55.4	68.4	82.7	98.4
	0.004	8.1	14.4	22.5	32.4	44.1	57.6	72.9	90.0	108.9	129.7
	0.005	10.0	17.8	27.8	40.0	54.5	71.1	90.0	111.2	134.5	160.1
	0.006	11.9	21.1	32.9	47.4	64.5	84.3	106.7	131.7	159.4	189.7
	0.007	13.7	24.3	37.9	54.6	74.3	97.1	122.9	151.7	183.6	218.5
	0.008	15.4	27.4	42.8	61.6	83.9	109.5	138.6	171.2	207.1	246.5
	0.009	17.1	30.4	47.5	68.4	93.1	121.6	153.9	190.0	230.0	273.7
	0.010	18.8	33.3	52.1	75.0	102.1	133.4	168.8	208.4	252.1	300.1
	0.011	20.4	36.2	56.5	81.4	110.8	144.7	183.2	226.1	273.6	325.6
28	0.002	4.2	7.4	11.6	16.7	22.7	29.7	37.6	46.4	56.2	66.8
	0.003	6.2	11.0	17.2	24.8	33.8	44.2	55.9	69.0	83.5	99.4
	0.004	8.2	14.6	22.8	32.8	44.7	58.3	73.8	91.2	110.3	131.3
	0.005	10.2	18.1	28.2	40.6	55.3	72.3	91.4	112.9	136.6	162.6
	0.006	12.1	21.5	33.6	48.3	65.8	85.9	108.7	134.2	162.4	193.3
	0.007	14.0	24.8	38.8	55.8	76.0	99.3	125.7	155.1	187.7	223.4
	0.008	15.8	28.1	43.9	63.2	86.1	112.4	142.3	175.6	212.5	252.9
	0.009	17.6	31.3	48.9	70.4	95.9	125.2	158.5	195.7	236.8	281.8
	0.010	19.4	34.5	53.8	77.5	105.5	137.8	174.4	215.3	260.6	310.1
	0.011	21.1	37.5	58.6	84.4	114.9	150.1	190.0	234.6	283.8	337.8
	0.012	22.8	40.5	63.3	91.2	124.2	162.2	205.2	253.4	306.6	364.9
	0.013	24.5	43.5	67.9	97.8	133.2	173.9	220.2	271.8	328.9	391.4
	0.014	26.1	46.4	72.4	104.3	142.0	185.5	234.7	289.8	350.6	417.3
	0.015	27.7	49.2	76.8	110.6	150.6	196.7	248.9	307.3	371.9	442.6
35	0.002	4.2	7.5	11.6	16.8	22.8	29.8	37.7	46.6	56.4	67.1
	0.003	6.2	11.1	17.3	25.0	34.0	44.4	56.2	69.4	83.9	99.9
	0.004	8.3	14.7	23.0	33.1	45.0	58.8	74.4	91.8	111.1	132.2
	0.005	10.3	18.2	28.5	41.0	55.8	72.9	92.3	113.9	137.9	164.1
	0.006	12.2	21.7	33.9	48.9	66.5	86.9	109.9	135.7	164.2	195.4
	0.007	14.1	25.1	39.3	56.6	77.0	100.6	127.3	157.2	190.2	226.3
	0.008	16.0	28.5	44.6	64.2	87.4	114.1	144.4	178.3	215.7	256.7
	0.009	17.9	31.9	49.8	71.7	97.5	127.4	161.3	199.1	240.9	286.7
	0.010	19.8	35.1	54.9	79.0	107.6	140.5	177.8	219.5	265.6	316.1
	0.011	21.6	38.3	59.9	86.3	117.4	153.4	194.1	239.6	290.0	345.1
	0.012	23.3	41.5	64.9	93.4	127.1	166.0	210.1	259.4	313.9	373.6
	0.013	25.1	44.6	69.7	100.4	136.6	178.5	225.9	278.9	337.4	401.6
	0.014	26.8	47.7	74.5	107.3	146.0	190.7	241.4	298.0	360.5	429.1
	0.015	28.5	50.7	79.2	114.0	155.2	202.7	256.6	316.7	383.3	456.1
	0.016	30.2	53.6	83.8	120.7	164.2	214.5	271.5	335.2	405.6	482.7
	0.017	31.8	56.5	88.3	127.2	173.1	226.1	286.2	353.3	427.5	508.7

TABLE A.10

Simplified tension development in bar diameters l_d/d_b for uncoated bars and normalweight concrete

		No. 19 (No. 6) and Smaller[a]			No. 22 (No. 7) and Larger		
		f'_c, MPa			f'_c, MPa		
	f_y, MPa	28	35	42	28	35	42
(1) Bottom bars							
Spacing, cover and ties as per Case *a* and *b*	280	25	23	21	31	28	25
	420	38	34	31	47	42	38
	520	47	42	38	58	52	47
Other cases	280	38	34	31	48	43	39
	420	57	51	46	72	65	59
	520	70	63	57	89	80	73
(2) Top bars							
Spacing, cover and ties as per Case *a* and *b*	280	33	29	27	40	36	33
	420	49	44	40	61	54	50
	520	61	54	50	75	67	61
Other cases	280	49	44	40	63	56	51
	420	74	66	60	94	84	77
	520	91	82	75	116	104	95

Case *a*: Clear spacing of bars being developed or spliced $\geq d_b$, clear cover $\geq d_b$, and stirrups or ties throughout l_d not less than the Code minimum.

Case *b*: Clear spacing of bars being developed or spliced $\geq 2d_b$, and clear cover not less than d_b.

[a] ACI Committee 408 recommends that the values indicated for bar sizes No. 22 (No. 7) and larger be used for all bar sizes.

TABLE A.11

Development length in compression, mm, for normalweight concrete

l_{dc} = greater of $(0.24f_y/\sqrt{f'_c})d_b$ or $0.043f_yd_b$ (Minimum of 200 mm in all cases)

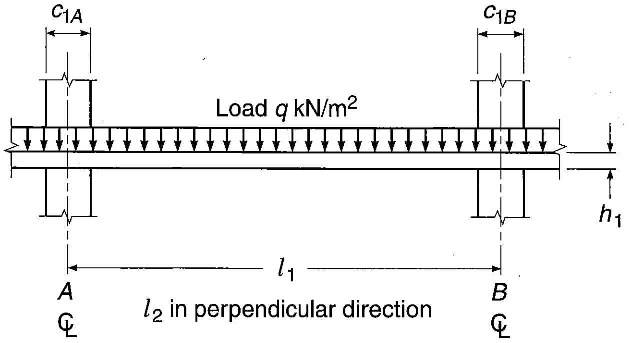
Bar No.			f'_c, MPa							
			21		28		35		42	
SI	Inch-Pound	f_y, MPa	Basic l_{dc}	Confined	Basic l_{dc}	Confined	Basic l_{dc}	Confined	Basic l_{dc}	Confined
10	3	280	200	200	200	200	200	200	200	200
		420	210	200	200	200	200	200	200	200
		520	260	200	220	200	210	200	210	200
13	4	280	200	200	200	200	200	200	200	200
		420	280	210	240	200	230	200	230	200
		520	350	260	300	220	280	210	280	210
16	5	280	230	200	200	200	200	200	200	200
		420	350	260	300	230	290	220	290	220
		520	430	320	380	280	360	270	360	270
19	6	280	280	210	240	200	230	200	230	200
		420	420	320	360	270	340	260	340	260
		520	520	390	450	340	430	320	430	320
22	7	280	330	240	280	210	270	200	270	200
		420	490	370	420	320	400	300	400	300
		520	600	450	520	390	500	370	500	370
25	8	280	370	280	320	240	310	230	310	230
		420	560	420	480	360	460	340	460	340
		520	690	520	600	450	570	430	570	430
29	9	280	420	320	360	270	350	260	350	260
		420	630	470	550	410	520	390	520	390
		520	780	590	680	510	640	480	640	480
32	10	280	470	360	410	310	390	290	390	290
		420	710	530	620	460	580	440	580	440
		520	880	660	760	570	720	540	720	540
36	11	280	520	390	450	340	430	320	430	320
		420	790	590	680	510	650	480	650	480
		520	970	730	840	630	800	600	800	600
43	14	280	630	470	550	410	520	390	520	390
		420	950	710	820	610	780	580	780	580
		520	1,170	880	1,010	760	960	720	960	720
57	18	280	840	630	730	550	690	520	690	520
		420	1,260	950	1,090	820	1,030	780	1,030	780
		520	1,560	1,170	1,350	1,010	1,280	960	1,280	960

TABLE A.12
Common stock styles of welded wire reinforcement (WWR)

Steel Designation[a]	Steel Area, mm²/m Longitudinal	 Transverse	Weight (Approximate), kg per m²
	Rolls		
152 × 152 − MW9 × MW9	59.3	59.3	1.03
152 × 152 − MW13 × MW13	84.7	84.7	1.46
152 × 152 − MW19 × MW19	122.8	122.8	2.05
152 × 152 − MW26 × MW26	169.4	169.4	2.83
102 × 102 − MW9 × MW9	88.9	88.9	1.51
102 × 102 − MW13 × MW13	127.0	127.0	2.15
102 × 102 − MW19 × MW19	184.2	184.2	3.03
102 × 102 − MW26 × MW26	254.0	254.0	4.30
	Sheets		
152 × 152 − MW19 × MW19	122.8	122.8	2.05
152 × 152 − MW26 × MW26	169.4	169.4	2.83
152 × 152 − MW30 × MW30	199.0	199.0	3.32
102 × 102 − MW26 × MW26	254.0	254.0	4.30

[a] The designation MW indicates plain wire; WWR is also available as deformed wire, designated by MD.

TABLE A.13A
Coefficients for slabs with variable moment of inertia[a]

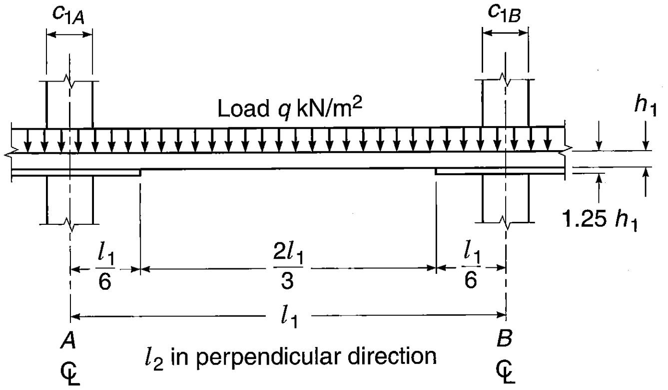


Column Dimension		Uniform Load FEM = Coeff.$(ql_2l_1^2)$		Stiffness Factor[b]		Carryover Factor	
c_{1A}/l_1	c_{1B}/l_1	M_{AB}	M_{BA}	k_{AB}	k_{BA}	COF_{AB}	COF_{BA}
0.00	0.00	0.083	0.083	4.00	4.00	0.500	0.500
	0.05	0.083	0.084	4.01	4.04	0.504	0.500
	0.10	0.082	0.086	4.03	4.15	0.513	0.499
	0.15	0.081	0.089	4.07	4.32	0.528	0.498
	0.20	0.079	0.093	4.12	4.56	0.548	0.495
	0.25	0.077	0.097	4.18	4.88	0.573	0.491
0.05	0.05	0.084	0.084	4.05	4.05	0.503	0.503
	0.10	0.083	0.086	4.07	4.15	0.513	0.503
	0.15	0.081	0.089	4.11	4.33	0.528	0.501
	0.20	0.080	0.092	4.16	4.58	0.548	0.499
	0.25	0.078	0.096	4.22	4.89	0.573	0.494
0.10	0.10	0.085	0.085	4.18	4.18	0.513	0.513
	0.15	0.083	0.088	4.22	4.36	0.528	0.511
	0.20	0.082	0.091	4.27	4.61	0.548	0.508
	0.25	0.080	0.095	4.34	4.93	0.573	0.504
0.15	0.15	0.086	0.086	4.40	4.40	0.526	0.526
	0.20	0.084	0.090	4.46	4.65	0.546	0.523
	0.25	0.083	0.094	4.53	4.98	0.571	0.519
0.20	0.20	0.088	0.088	4.72	4.72	0.543	0.543
	0.25	0.086	0.092	4.79	5.05	0.568	0.539
0.25	0.25	0.090	0.090	5.14	5.14	0.563	0.563

[a] Applicable when $c_1/l_1 = c_2/l_2$. For other relationships between these ratios, the constants will be slightly in error.

[b] Stiffness is $K_{AB} = k_{AB}E(l_2h_1^3/12l_1)$ and $K_{BA} = k_{BA}E(l_2h_1^3/12l_1)$.

TABLE A.13B
Coefficients for slabs with variable moment of inertia[a]



Column Dimension		Uniform Load FEM = Coeff.$(ql_2l_1^2)$		Stiffness Factor[b]		Carryover Factor	
c_{1A}/l_1	c_{1B}/l_1	M_{AB}	M_{BA}	k_{AB}	k_{BA}	COF$_{AB}$	COF$_{BA}$
0.00	0.00	0.088	0.088	4.78	4.78	0.541	0.541
	0.05	0.087	0.089	4.80	4.82	0.545	0.541
	0.10	0.087	0.090	4.83	4.94	0.553	0.541
	0.15	0.085	0.093	4.87	5.12	0.567	0.540
	0.20	0.084	0.096	4.93	5.36	0.585	0.537
	0.25	0.082	0.100	5.00	5.68	0.606	0.534
0.05	0.05	0.088	0.088	4.84	4.84	0.545	0.545
	0.10	0.087	0.090	4.87	4.95	0.553	0.544
	0.15	0.085	0.093	4.91	5.13	0.567	0.543
	0.20	0.084	0.096	4.97	5.38	0.584	0.541
	0.25	0.082	0.100	5.05	5.70	0.606	0.537
0.10	0.10	0.089	0.089	4.98	4.98	0.553	0.553
	0.15	0.088	0.092	5.03	5.16	0.566	0.551
	0.20	0.086	0.094	5.09	5.42	0.584	0.549
	0.25	0.084	0.099	5.17	5.74	0.606	0.546
0.15	0.15	0.090	0.090	5.22	5.22	0.565	0.565
	0.20	0.089	0.094	5.28	5.47	0.583	0.563
	0.25	0.087	0.097	5.37	5.80	0.604	0.559
0.20	0.20	0.092	0.092	5.55	5.55	0.580	0.580
	0.25	0.090	0.096	5.64	5.88	0.602	0.577
0.25	0.25	0.094	0.094	5.98	5.98	0.598	0.598

[a] Applicable when $c_1/l_1 = c_2/l_2$. For other relationships between these ratios, the constants will be slightly in error.

[b] Stiffness is $K_{AB} = k_{AB}E(l_2h_1^3/12l_1)$ and $K_{BA} = k_{BA}E(l_2h_1^3/12l_1)$.