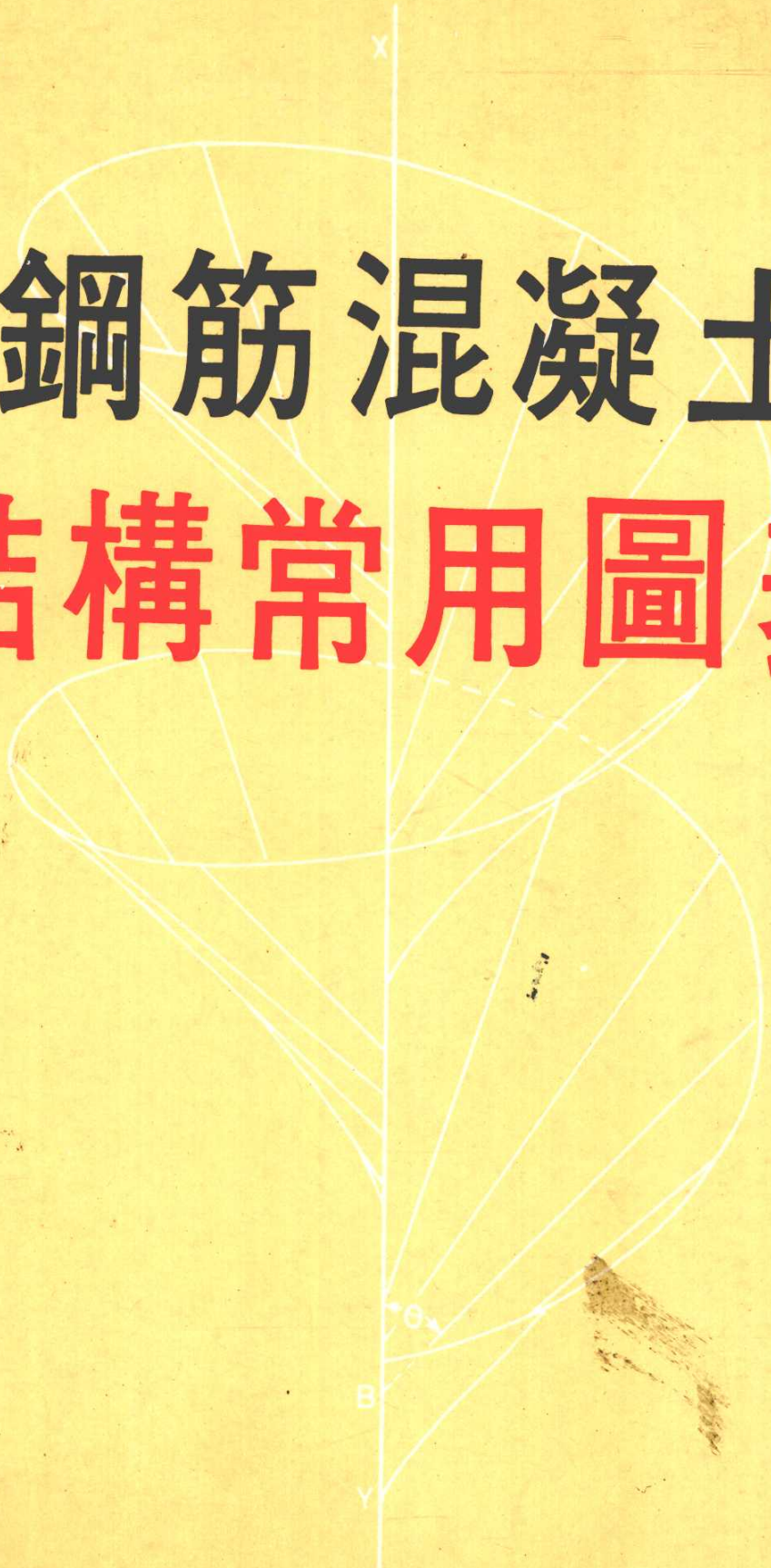
DESIGN CHARTS FOR REINFORCED CONCRETE STRUCTURES

鋼筋混凝土
結構常用圖表



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第一部份　樓板的設計

Part I　DESIGN OF SLABS

f_c = 1000 #/□"　　f_t = 18000 #/□"　　COVER = ½"

D (IN.)	d (IN.)	a (IN.)	R.M. (IN.LB.)	DIA. OF RFT.	R.M. (IN. LB.)										at	FOR LONG WAY OF TWO WAY SLAB		
					3"c/c	3½"c/c	4"c/c	4½"c/c	5"c/c	5½"c/c	6"c/c	7"c/c	8"c/c	9"c/c		d'	a'	a't
3	2.375	2.02	13050	¼"φ	7130	6110	5340	4760	—	—	—	—	—	—	36400	—	—	—
3½	2.875	2.44	19150	¼"φ	8600	7380	6460	5760	5180	4700	—	—	—	—	44000	—	—	—
	2.810	2.38	18400	3/8" φ	—	16250	14200	12650	11360	10320	9460	—	—	—	42800	—	—	—
4	3.375	2.86	26400	¼"φ	10100	8650	7570	6750	6070	5510	5040	4320	—	—	51500	3.125	2.66	47750
	3.310	2.81	25400	3/8"φ	22350	19200	16700	14900	13400	12200	11200	9550	8400	7430	50500	2.938	2.50	44800
4½	3.875	3.29	34700	¼"φ	11620	9960	8700	7760	7000	6350	5810	4980	4390	3860	59200	3.625	3.08	55400
	3.810	3.23	33600	3/8"φ	25700	22100	19250	17150	15420	14100	12850	11000	9650	8550	58100	3.438	2.92	52600
	3.750	3.18	32500	½"φ	—	—	—	30000	27000	24580	22500	19300	16880	15000	57200	3.250	2.76	49600
5	4.375	3.71	44200	¼"φ	13100	11200	9830	8750	7880	7160	6560	5620	4950	4340	66700	4.125	3.50	63000
	4.310	3.65	43000	3/8"φ	29100	24950	21800	19420	17450	15880	14560	12440	10930	9680	65900	3.938	3.35	60200
	4.250	3.61	41800	½"φ	—	—	—	34080	30600	27850	25350	21900	19180	17030	64800	3.750	3.19	57300
5½	4.875	4.13	55000	¼" φ	14580	12480	10920	9750	8780	7940	7290	6250	5520	4830	74400	4.625	3.93	70700
	4.810	4.08	53500	3/8" φ	32500	27800	24400	21650	19440	17740	16240	13860	12200	10800	73500	4.438	3.77	67800
	4.750	4.03	52200	½" φ	—	48800	42600	38000	34200	31100	28500	24500	21400	19000	72500	4.250	3.61	65000
6	5.375	4.56	67000	¼"φ	16100	13800	12050	10780	9700	8800	8050	6900	6080	5340	82100	5.125	4.35	78500
	5.310	4.50	65300	3/8 "φ	35800	30700	26900	23900	21500	19600	17940	15300	13440	11900	81000	4.938	4.20	75500
	5.250	4.45	63800	½"φ	62900	54000	47200	42000	37800	34300	31500	27000	23900	21000	80100	4.750	4.03	72600
6½	5.875	4.98	79700	¼"φ	17600	15100	13180	11760	10620	9600	8800	7540	6630	5830	89600	5.625	4.78	86100
	5.810	4.93	78000	3/8"φ	39200	33600	29500	26200	23500	21400	19650	16800	14750	13050	88700	5.438	4.62	83000
	5.750	4.88	76600	½"φ	69000	59100	51700	46000	41500	37600	34500	29600	25900	23100	88000	5.250	4.46	80200
7	6.375	5.41	94100	¼" φ	19100	16380	14300	12800	11500	10420	9570	8200	7220	6340	97500	6.125	5.21	93700
	6.310	5.35	92300	3/8"φ	42600	36500	32000	28400	25500	23300	21300	18200	16000	14150	96500	5.938	5.05	90900
	6.250	5.30	90500	½"φ	74900	64200	56100	50000	45000	40900	37500	32200	28100	25000	95500	5.750	4.88	88000

NOTES:
1. PITCH OF REINFORCEMENTS: FOR MAIN BARS ≤ 3d; FOR DISTRIBUTION BARS ≤ 5d.
2. MINIMUM REINFORCEMENT FOR MAIN BARS AND DISTRIBUTION BARS = 0.01bd
3. MAX. VALUES OF SPAN/DEPTH RATIO OF SLABS:
   SPANNING IN ONE DIRECTION: FREELY-SUPPORTED: 30, CONTINUOUS: 35, CANTILEVERED: 12
   SPANNING IN TWO DIRECTIONS: FREELY-SUPPORTED: 35, CONTINUOUS: 40.

樓板的設計 DESIGN OF SLAB

f_c = 1000#/□" f_t = 20,000#/□" COVER = ½"

D (IN.)	d (IN.)	a (IN.)	R.M. (IN-LB)	DIA.OF RFT.	R.M. (IN-LB)										at	FOR LONG WAY OF TWO WAY SLAB		
					3" c/c	3½"c/c	4"c/c	4½"c/c	5"c/c	5½"c/c	6"c/c	7"c/c	8"c/c	9"c/c		d'	a	a't
3	2.375	2.04	12410	¼"φ	7980	6840	5980	5330	—	—	—	—	—	—	40710	—	—	—
3½	2.875	2.46	18190	¼"φ	9660	8280	7240	6460	5810	5270	4830	—	—	—	49280	—	—	—
	2.810	2.41	17370	⅜"φ	—	—	15940	14210	12760	11610	10640	9100	—	—	48160	—	—	—
4	3.375	2.89	25060	¼"φ	11340	9720	8500	7580	6830	6190	5670	4859	4280	—	57850	3.125	2.68	53560
	3.310	2.84	24110	⅜"φ	—	21500	18780	16740	15030	13670	12540	10720	9420	9340	56730	2.938	2.52	50360
4½	3.875	3.32	33040	¼"φ	13020	11160	9760	8700	7840	7110	6510	5580	4910	4320	66420	3.625	3.11	62130
	3.810	3.27	31940	⅜"φ	28860	24750	21620	19260	17310	15740	14430	12340	10840	9600	65300	3.438	2.95	58930
	3.750	3.21	30940	½"φ	—	—	—	—	30270	27570	25260	21660	18960	16840	64270	3.250	2.79	55700
5	4.375	3.75	42110	¼"φ	14700	12600	11020	9820	8850	8020	7350	6300	5550	4870	74990	4.125	3.54	70700
	4.310	3.69	40870	⅜"φ	32650	28000	24450	21800	19600	17800	16330	13960	12260	10860	73870	3.938	3.37	67500
	4.250	3.64	39740	½"φ	—	—	—	38170	34310	31180	28630	24550	21490	19090	72840	3.750	3.21	64270
5½	4.875	4.18	52290	¼"φ	16380	14040	12280	10950	9860	8940	8190	7020	6180	5430	83560	4.625	3.96	79300
	4.810	4.12	50900	⅜"φ	36440	31250	27290	24320	21850	19870	18220	15580	13690	12120	82440	4.438	3.80	76070
	4.750	4.07	49640	½"φ	—	—	47950	42660	38350	34850	32320	27440	24020	21330	81410	4.250	3.64	72840
6	5.375	4.61	63570	¼"φ	18060	15480	13540	12070	10870	9860	9030	7740	6820	5990	92130	5.125	4.39	87840
	5.310	4.55	62040	⅜"φ	40230	34490	30120	26850	24120	21930	20110	17200	15110	13380	91010	4.938	4.23	84640
	5.250	4.50	60640	½"φ	—	60560	53000	47150	42380	38510	35360	30320	26550	23580	89980	4.750	4.07	81410
6½	5.875	5.03	75940	¼"φ	19520	16730	14640	13050	11750	10660	9760	8360	7370	6470	100700	5.625	4.82	96410
	5.810	4.98	74270	⅜"φ	44020	37740	32960	29380	26390	24000	22010	18820	16530	14640	99580	5.438	4.66	93210
	5.750	4.93	72740	½"φ		66330	58050	51640	46420	42180	38730	33210	29070	25820	98550	5.250	4.50	89980
	6.375	5.46	89420	¼"φ	21420	18360	16060	14310	12890	11690	12130	9180	8090	7100	109270	6.125	5.25	104980
	6.310	5.41	87600	⅜"φ	47800	40990	35800	31900	28660	26060	23900	20440	17950	15900	108150	5.938	5.09	101780
	6.250	5.36	85950	½"φ	84090	72090	63100	56130	50460	45850	42100	36100	31600	28070	107120	5.750	4.88	98550

NOTES: 1. PITCH OF REINFORCEMENTS: FOR MAIN BARS ≤ 3d ; FOR DISTRIBUTION BARS ≤ 5d.

2. MINIMUM REINFORCEMENT: FOR MAIN BARS AND DISTRIBUTION BARS = 0.01 bd

3. MAX VALUES OF SPAN/DEPTH RATIO OF SLABS:

SPANNING IN ONE DIRECTION: FREELY-SUPPORTED: 30 CONTINUOUS: 35 CANTILEVERED: 12

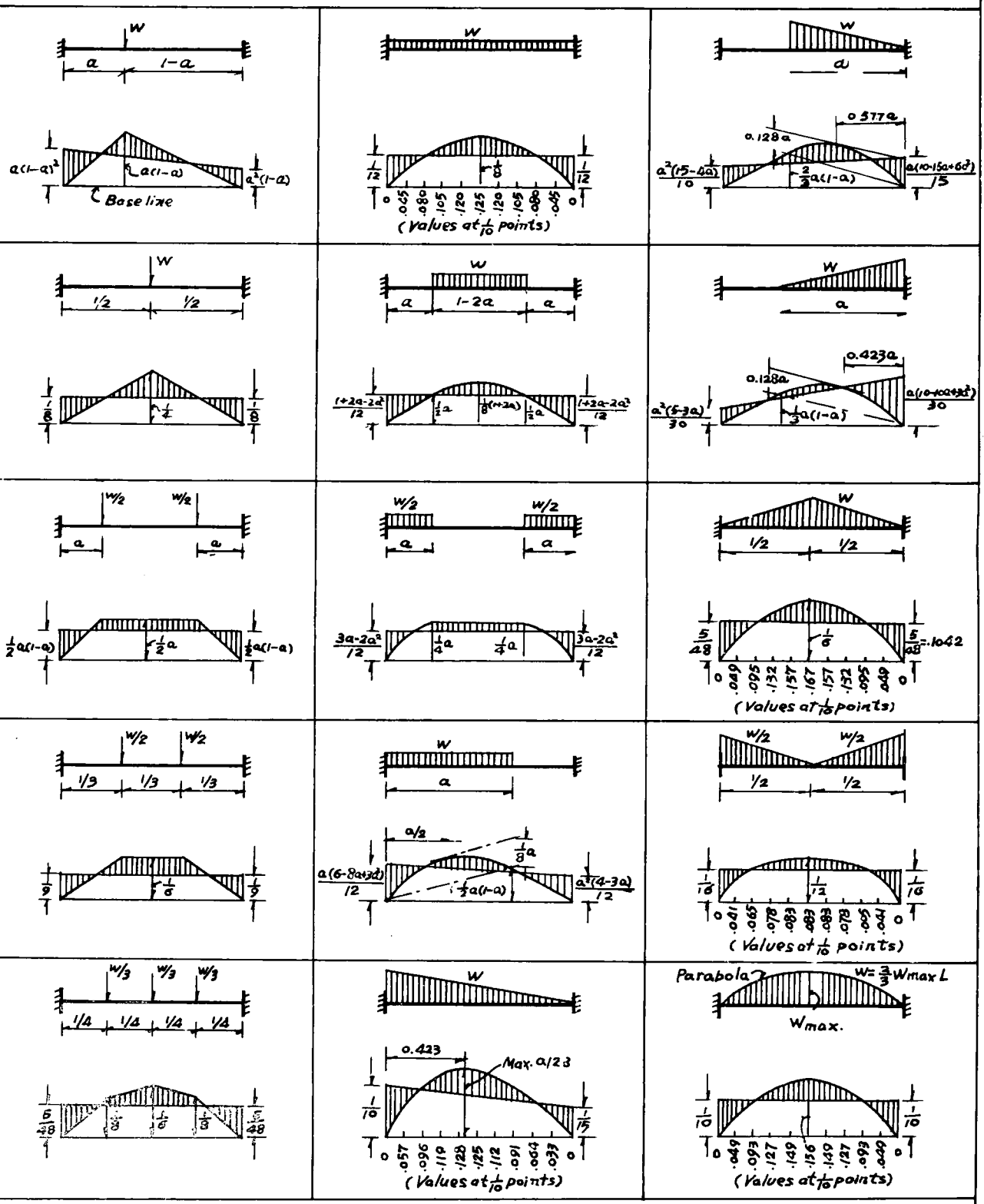
SPANNING IN TWO DIRECTIONS: FREELY-SUPPORTED: 35 CONTINUOUS: 40

等截面樑的固端彎矩——各種類型荷重

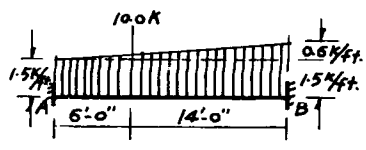
FIXED END MOMENTS IN BEAMS OF CONSTANT SECTION

$M = m \times W \times L$

m = coefficient taken from diagram
W = total load on beam
L = length of beam
a = length in terms of L



EXAMDLE:



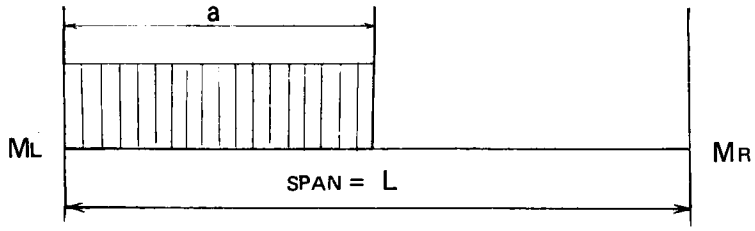
Fixed end moments

$0.3 \times 0.7^2(10.0)\,20 = 29.4$ | $0.3^2 \times 0.7(10.0)\,20 = 12.6$
$\frac{1}{12}(1.5 \times 20)\,20 = 50.0$ | $\frac{1}{12}(1.5 \times 20)\,20 = 50.0$
$\frac{1}{15}(\frac{1}{2} \times 0.6 \times 20)\,20 = 8.0$ | $\frac{1}{10}(\frac{1}{2} \times 0.6 \times 20)\,20 = 12.0$

$M^F_{AB} = 87.4$ ft kip $\quad M^F_{BA} = 74.6$ ft kip

部份均佈荷載的固端彎矩係數

FIXED END MOMENT COEFFICIENTS OF PARTIAL UNIFORMLY DISTRIBUTED LOAD



$$\overline{M}_L = \frac{Wa}{12L^2}(3a^2 - 8aL + 6L^2)$$

$$\overline{M}_R = \frac{Wa^2}{12L^2}(4L - 3a)$$

a/L	$\overline{M}_L$	$\overline{M}_R$	a/L	$\overline{M}_L$	$\overline{M}_R$	a/L	$\overline{M}_L$	$\overline{M}_R$	a/L	$\overline{M}_L$	$\overline{M}_R$
.01	.0050	.0000	.26	.0894	.0182	.51	.1148	.0536	.76	.1047	.0829
.02	.0095	.0000	.27	.0913	.0194	.52	.1149	.0550	.77	.1038	.0839
.03	.0144	.0003	.28	.0933	.0206	.53	.1150	.0563	.78	.1030	.0840
.04	.0190	.0005	.29	.0959	.0220	.54	.1150	.0580	.79	.1020	.0848
.05	.0234	.0008	.30	.0967	.0233	.55	.1149	.0592	.80	.1013	.0853
.06	.0277	.0012	.31	.0985	.0246	.56	.1148	.0609	.81	.1001	.0860
.07	.0320	.0016	.32	.0999	.0260	.57	.1147	.0620	.82	.0995	.0862
.08	.0360	.0020	.33	.1012	.0274	.58	.1145	.0633	.83	.0988	.0868
.09	.0398	.0026	.34	.1026	.0287	.59	.1143	.0648	.84	.0980	.0872
.10	.0436	.0031	.35	.1040	.0301	.60	.1140	.0660	.85	.0970	.0874
.11	.0474	.0037	.36	.1049	.0315	.61	.1135	.0674	.86	.0960	.0878
.12	.0510	.0043	.37	.1061	.0330	.62	.1133	.0685	.87	.0950	.0878
.13	.0542	.0051	.38	.1076	.0345	.63	.1130	.0697	.88	.0940	.0880
.14	.0576	.0059	.39	.1083	.0359	.64	.1125	.0710	.89	.0930	.0880
.15	.0610	.0067	.40	.1093	.0373	.65	.1120	.0721	.90	.0923	.0878
.16	.0640	.0075	.41	.1102	.0388	.66	.1115	.0731	.91	.0914	.0877
.17	.0664	.0084	.42	.1110	.0403	.67	.1110	.0743	.92	.0906	.0874
.18	.0699	.0093	.43	.1116	.0417	.68	.1103	.0757	.93	.0897	.0872
.19	.0728	.0103	.44	.1122	.0434	.69	.1100	.0764	.94	.0888	.0869
.20	.0754	.0114	.45	.1128	.0448	.70	.1091	.0776	.95	.0878	.0866
.21	.0779	.0124	.46	.1133	.0462	.71	.1083	.0784	.96	.0869	.0860
.22	.0804	.0135	.47	.1136	.0476	.72	.1076	.0796	.97	.0860	.0854
.23	.0830	.0146	.48	.1140	.0493	.73	.1072	.0800	.98	.0850	.0849
.24	.0850	.0158	.49	.1144	.0507	.74	.1060	.0814	.99	.0841	.0840
.25	.0874	.0169	.50	.1146	.0521	.75	.1055	.0820	1.00	.0833	.0833

部份三角形荷載的固端彎矩係數——第一種情況

FIXED END MOMENT COEFFICIENTS OF TRIANGULAR LOAD – Case 1

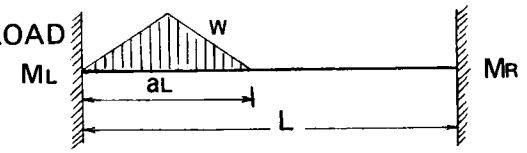
$$M_R = \frac{a^2}{48}(14 - 9a)\, w_L$$

$$= K_R WL$$

$$M_L = \frac{a}{48}(24 - 28a + 9a^2)\, w_L$$

$$= K_L WL$$

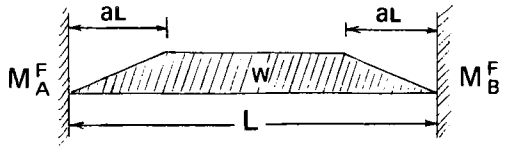
W = TOTAL LOAD



a	KL	KR	a	KL	KR	a	KL	KR	a	KL	KR
.01			.26	.0939	.0164	.51	.1281	.0510	.76	.1254	.0861
.02			.27	.0962	.0176	.52	.1286	.0525	.77	.1247	.0872
.03			.28	.0984	.0187	.53	.1290	.0540	.78	.1240	.0884
.04			.29	.1005	.0200	.54	.1294	.0555	.79	.1232	.0895
.05			.30	.1025	.0212	.55	.1298	.0570	.80	.1227	.0907
.06			.31	.1045	.0225	.56	.1300	.0585	.81	.1219	.0917
.07			.32	.1064	.0237	.57	.1302	.0560	.82	.1211	.0927
.08			.33	.1082	.0250	.58	.1304	.0615	.83	.1203	.0937
.09			.34	.1100	.0264	.59	.1305	.0630	.84	.1195	.0947
.10			.35	.1116	.0277	.60	.1305	.0645	.85	.1186	.0956
.11			.36	.1131	.0291	.61	.1305	.0660	.86	.1176	.0964
.12			.37	.1145	.0305	.62	.1305	.0674	.87	.1168	.0972
.13			.38	.1161	.0318	.63	.1304	.0688	.88	.1160	.0980
.14			.39	.1174	.0332	.64	.1302	.0703	.89	.1151	.0988
.15			.40	.1186	.0346	.65	.1300	.0718	.90	.1142	.0995
.16			.41	.1199	.0361	.66	.1298	.0732	.91	.1132	.1002
.17			.42	.1210	.0376	.67	.1295	.0745	.92	.1122	.1008
.18			.43	.1220	.0390	.68	.1292	.0760	.93	.1113	.1014
.19			.44	.1230	.0405	.69	.1289	.0772	.94	.1102	.1020
.20	.0782	.0102	.45	.1240	.0420	.70	.1285	.0786	.95	.1093	.1024
.21	.0810	.0111	.46	.1248	.0434	.71	.1280	.0799	.96	.1083	.1028
.22	.0838	.0121	.47	.1255	.0449	.72	.1275	.0812	.97	.1072	.1034
.23	.0864	.0131	.48	.1263	.0465	.73	.1271	.0825	.98	.1062	.1036
.24	.0890	.0142	.49	.1270	.0480	.74	.1265	.0838	.99	.1052	.1040
.25	.0915	.0153	.50	.1276	.0495	.75	.1260	.0849	1.00	.1042	.1042

梯形荷載的固端彎矩係數

FIXED END MOMENT COEFFICIENTS OF TRAPEZOIDAL LOAD



W = TOTAL LD.
= wL(1 − a)
w = UNIT LD.

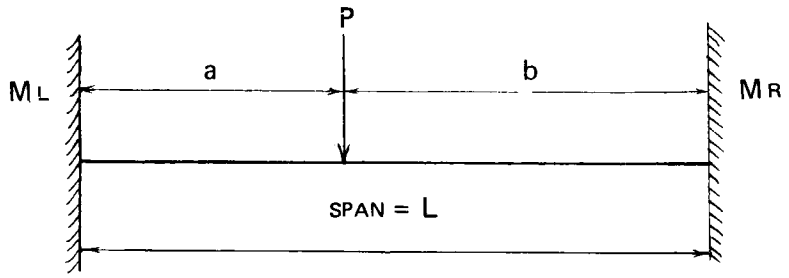
(MAX FREE B.M. AT MID SPAN)

$$M_A^F = M_B^F = wL^2/12\,(1-2a^2+a^3) = KwWL^2$$
$$= wL^2/12(1+a-a^2) = KwWL$$

$$Mc = \frac{wL^2}{24}(3-4a^2) = wL\frac{(3-4a^2)}{24(1-a)}$$
$$= KcWL$$

Kc	a	Kw	K	Kc	a	Kw	K
.127	.01	.0833	.0842	.153	.26	.0735	.0994
.129	.02	.0833	.0850	.154	.27	.0728	.0998
.130	.03	.0832	.0858	.155	.28	.0721	.1001
.131	.04	.0831	.0866	.156	.29	.0713	.1005
.132	.05	.0830	.0873	.157	.30	.0706	.1009
.133	.06	.0827	.0880	.158	.31	.0698	.1012
.134	.07	.0825	.0888	.159	.32	.0690	.1015
.135	.08	.0823	.0895	.160	.33	.0682	.1018
.136	.09	.0820	.0902	.161	.34	.0673	.1021
.137	.10	.0817	.0909	.161	.35	.0665	.1023
.138	.11	.0814	.0916	.162	.36	.0656	.1025
.139	.12	.0811	.0922	.162	.37	.0647	.1027
.140	.13	.0807	.0928	.163	.38	.0638	.1029
.141	.14	.0803	.0934	.163	.39	.0629	.1031
.142	.15	.0799	.0940	.164	.40	.0620	.1033
.143	.16	.0794	.0945	.164	.41	.0611	.1035
.144	.17	.0789	.0951	.165	.42	.0601	.1037
.145	.18	.0784	.0956	.165	.43	.0591	.1038
.146	.19	.0779	.0961	.165	.44	.0582	.1039
.147	.20	.0773	.0960	.166	.45	.0572	.1040
.148	.21	.0767	.0971	.166	.46	.0562	.1040
.149	.22	.0761	.0976	.166	.47	.0552	.1041
.150	.23	.0755	.0931	.167	.48	.0541	.1041
.151	.24	.0749	.0986	.167	.49	.0531	.1042
.152	.25	.0742	.0990	.167	.50	.0521	.1042

集中荷載的固端彎矩係數
FIXED END MOMENTS COEFFICIENTS OF POINT LOAD



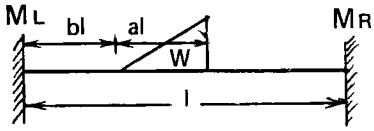
$$M_L = \frac{Pab^2}{L^2} = K_L P \cdot L$$

$$M_R = \frac{Pa^2 b}{L^2} = K_R P \cdot L$$

a/L	KL	KR	a/L	KL	KR	a/L	KL	KR	a/L	KL	KR
.01	.0098	.0001	.26	.1424	.0500	.51	.1225	.1274	.76	.0438	.1386
.02	.0192	.0004	.27	.1439	.0532	.52	1198	.1298	.77	.0407	.1364
.03	.0282	.0009	.28	.1452	.0564	.53	.1171	.1320	.78	.0378	.1338
.04	.0369	.0015	.29	.1462	.0597	.54	.1143	.1341	.79	.0348	.1311
.05	.0451	.0024	.30	.1470	.0636	.55	.1114	.1361	.80	.0320	.1280
.06	.0530	.0034	.31	.1476	.0663	.56	.1084	.1380	.81	.0292	.1247
.07	.0605	.0046	.32	.1480	.0696	.57	.1054	.1397	.82	.0266	.1210
.08	.0677	.0059	.33	.1481	.0730	.58	.1023	.1413	.83	.0240	.1171
.09	.0745	.0074	.34	.1481	.0763	.59	.0992	.1427	.84	.0215	.1129
.10	.0810	.0090	.35	.1479	.0796	.60	.0960	.1440	.85	.0191	.1084
.11	.0871	.0108	.36	.1475	.0829	.61	.0928	.1451	.86	.0169	.1035
.12	.0929	.0127	.37	.1469	.0862	.62	.0895	.1461	.87	.0147	.0984
.13	.0984	.0147	.38	.1461	.0895	.63	.0862	.1469	.88	.0127	.0929
.14	.1035	.0169	.39	.1451	.0928	.64	.0829	.1475	.89	.0108	.0871
.15	.1084	.0191	.40	.1440	.0960	.65	.0796	.1479	.90	.0090	.0810
.16	.1129	.0215	.41	.1427	.0992	.66	.0763	.1481	.91	.0074	.0745
.17	.1171	.0240	.42	.1413	.1023	.67	.0730	.1481	.92	.0059	.0677
.18	.1210	.0266	.43	.1397	.1054	.68	.0696	.1480	.93	.0046	.0605
.19	.1247	.0292	.44	.1380	.1084	.69	.0663	.1476	.94	.0034	.0530
.20	.1280	.0320	.45	.1361	.1114	.70	.0636	.1470	.95	.0024	.0451
.21	.1311	.0348	.46	.1341	.1143	.71	.0597	.1462	.96	.0015	.0369
.22	.1338	.0378	.47	.1320	.1171	.72	.0564	.1452	.97	.0009	.0282
.23	.1364	.0407	.48	.1298	.1198	.73	.0532	.1439	.98	.0004	.0192
.24	.1386	.0438	.49	.1274	.1225	.74	.0500	.1424	.99	.0001	.0098
.25	.1406	.0469	.50	.1250	.1250	.75	.0469	.1406	1.00	.0000	.0000

部份三角形荷重的固端彎矩係數——第二種情況
FIXED END MOMENTS COEFFICIENTS OF PARTIAL TRIANGULAR LOAD – Case 2

$$M_L{}^{11}\# = \left\{ \frac{1}{3}(1-a)\,[a + (a+3b)(1-a-2b)] + \frac{a^2}{30}(2a-5b) + b^3 \right\} w_L{}^1\,\#\times 12$$



COEFFICIENTS X $W\#L^{11} = M^{11}\#$

$$M_R{}^{11}\# = \left[\frac{a^2}{10}(5-4a) + b^2(1-b) - \frac{ab}{6}(9a+12b-8) \right] w_L{}^1\,\# \times 12$$

W = # L = Feet.

W = # L = Feet.

a		b											a
		0	.05	.10	.15	.20	.25	.30	.35	.40	.45		
.05	KL	.369	.837	1.200	1.482	1.640	1.742	1.775	1.745	1.670	1.544	KL	.105
	KB	.014	.077	.187	.331	.500	.690	.887	1.184	1.278	1.450	KR	
.10	KL	.682	1.082	1.378	1.585	1.702	1.765	1.756	1.695	1.588	1.444	KL	.10
	KB	.054	.161	.281	.444	.603	.823	1.032	1.215	1.390	1.545	KR	
.15	KL	.942	1.280	1.595	1.670	1.772	1.758	1.712	1.622	1.492	1.330	KL	.15
	KB	.119	.233	.390	.566	.745	.955	1.148	1.330	1.492	1.624	KR	
.20	KL	1.156	1.430	1.610	1.714	1.750	1.722	1.650	1.532	1.380	1.210	KL	.20
	KB	.202	.342	.510	.695	.888	1.118	1.270	1.438	1.578	1.682	KR	
.25	KL	1.320	1.540	1.670	1.730	1.638	1.670	1.568	1.430	1.275	1.080	KL	.25
	KB	.301	.456	.636	.825	1.010	1.202	1.378	1.526	1.640	1.715	KR	
.30	KL	1.444	1.612	1.695	1.715	1.678	1.591	1.468	1.248	1.138	.950	KL	.30
	KB	.410	.580	.765	.954	1.142	1.318	1.472	1.595	1.682	1.720	KR	
.35	KL	1.530	1.650	1.694	1.680	1.610	1.500	1.360	1.096	1.010	.822	KL	.35
	KB	.530	.706	.892	1.068	1.256	1.416	1.549	1.644	1.700	1.692	KR	
.40	KL	1.584	1.655	1.662	1.615	1.520	1.394	1.240	1.066	.882	.700	KL	.40
	KB	.652	.834	1.018	1.194	1.356	1.495	1.600	1.662	1.675	1.628	KR	
.45	KL	1.606	1.637	1.612	1.538	1.422	1.280	1.118	.940	.684	.588	KL	.45
	KB	.777	.956	1.132	1.298	1.440	1.552	1.628	1.892	1.662	1.528	KR	
.50	KL	1.600	1.560	1.540	1.442	1.317	1.042	.994	.818	.648	.488	KL	.50
	KB	.900	1.072	1.240	1.384	1.504	1.590	1.625	1.610	1.532	1.380	KR	
.55	KL	1.570	1.536	1.456	1.342	1.201	1.042	.875	.706	.547	.406	KL	.55
	KB	1.015	1.180	1.326	1.452	1.542	1.592	1.590	1.530	1.400	1.190	KR	
.60	KL	1.518	1.458	1.361	1.234	1.084	.924	.760	.604	.461	.351	KL	.50
	KB	1.124	1.272	1.400	1.496	1.554	1.566	1.518	1.406	1.220	1.112	KR	
.65	KL	1.448	1.370	1.258	1.120	.970	.812	.658	.516	.295	.430	KL	.45
	KB	1.218	1.346	1.446	1.514	1.536	1.500	1.406	1.240	1.100	1.354	KR	
.70	KL	1.365	1.270	1.150	1.008	.856	.710	.568	.242	.371	.527	KL	.40
	KB	1.292	1.400	1.470	1.500	1.482	1.400	1.252	1.036	1.310	1.510	KR	
.75	KL	1.270	1.168	1.040	.900	.756	.618	.193	.314	.478	.637	KL	.35
	KB	1.350	1.430	1.466	1.456	1.386	1.256	.960	1.270	1.490	1.626	KR	
.80	KL	1.180	1.062	.934	.797	.666	.148	.259	.406	.576	.758	KL	.30
	KB	1.382	1.426	1.426	1.372	1.254	.484	1.210	1.456	1.614	1.700	KR	
.85	KL	1.080	.960	.834	.708	.107	.209	.347	.512	.695	.875	KL	.25
	KB	1.386	1.395	1.350	1.246	.770	1.136	1.410	1.592	1.700	1.738	KR	
.90	KL	.980	.864	.745	.070	.161	.290	.450	.630	.763	1.019	KL	.20
	KB	1.360	1.326	1.232	.647	1.018	1.350	1.560	1.690	1.748	1.740	KR	
.95	KL	.886	.776	.041	.119	.238	.390	.566	.756	.955	1.148	KL	.15
	KB	1.300	1.220	.316	.952	1.276	1.514	1.668	1.746	1.760	1.720	KR	
1.00	KL	.740	.192	.082	.189	.331	.506	.692	.888	1.152	1.275	KL	.10
	KB	1.200	.360	.826	1.190	1.456	1.636	1.738	1.772	1.742	1.664	KR	
		.005	.052	.144	.278	.442	.624	.820	1.022	1.215	1.390	KL	.05
		.192	.696	1.090	1.388	1.592	1.720	1.772	1.760	1.700	1.584	KR	
3		.95	.90	.85	.80	.75	.70	.65	.60	.55	.50		0

矩形樑的設計
DESIGN OF RECTANGULAR BEAMS

j=al=0.872
k=nl=0.385
c= 750/P.S.I.
t= 18,000/P.S.I.

D.	RMc	At.	Ac	Unit Shear	Effective depth
9"	63,000	118,000		58.5	
10	81,800	134,000	39,800	66.9	8.5
11	102,000	149,600	49,500	74.8	9.5
12	124,000	165,400	59,400	82.7	10.5
13	149,000	181,000	69,400	90.5	11.5
14	177,000	197,000	79,500	98.5	12.5
15	206,000	213,000	89,700	108.3	13.5
16	238,000	228,000	100,000	114.2	14.5
17	272,000	244,000	110,000	122.0	15.5
18	307,000	260,000	120,000	130.0	16.5
19	346,000	276,000	131,000	138.0	17.5
20	387,000	292,000	141,000	145.8	18.5
21	430,000	307,000	151,000	153.6	19.5
22	475,000	323,000	162,000	161.5	20.5
23	522,000	339,000	172,000	169.3	21.5
24	571,000	354,000	182,000	177.2	22.5
25	624,000	370,000	193,000	185.0	23.5
26	679,000	386,000	203,000	193.0	24.5
27	735,000	402,000	214,000	201.0	25.5
28	792,000	417,000	224,000	209.0	26.5
29	855,000	434,000	234,000	216.0	27.5
30	920,000	450,000	244,000	224.0	28.5
31	1,000,000	465,000	254,000	232.0	
32	1,060,000	480,000	264,000	240.0	
33	1,120,000	496,000	274,000	248.0	
34	1,200,000	512,000	254,000	255.0	
35	1,260,000	526,000	294,000	263.0	
36	1,240,000	544,000	304,000	271.0	

$$Ac = \frac{\text{Excess. Moment}}{\text{Value from table}} = \text{sq. in.}$$

Excess M = Bending Moment − RMc

$$At = \frac{\text{Bending Moment}}{\text{Value from table}} = \text{sq. in.}$$

$$\text{Unit Shear} = \frac{\text{Reaction at end}}{\text{Value from table}} = \text{lbs/sq. in.}$$

矩形樑的設計 DESIGN OF R. C. BEAM

Resisting Moment of
Rectangular Beams and Tee Beams

C = 750/P.S.I.
t = 18,000/P.S.I.

b_r x D	Effective depth d	MR for RECT. b = 9"	MR for Tee Beam Breath of flange = 1" ds = 4" B up to 57"	ds = 4½" B up to 63"	ds = 5" B up to 69"	ds = 5½" B up to 75"	ds = 6" B up to 81"
9 x 10	8.5	88,000	9,000	9,000	9,000	9,140	9,140
9 x 11	9.5	102,500	11,200	11,200	11,400	11,400	11,400
9 x 12	10.5	125,000	13,000	13,700	14,000	14,000	14,000
9 x 13	11.5	150,000	16,200	16,200	16,200	16,700	16,700
9 x 14	12.5	177,800	19,000	19,100	19,700	19,800	20,800
9 x 15	13.5	207,000	21,800	22,000	22,300	23,000	23,000
9 x 16	14.5	239,500	24,600	25,800	25,800	25,800	26,800
9 x 17	15.5	273,000	26,400	28,600	29,200	29,400	30,300
9 x 18	16.5	309,500	30,300	31,700	32,600	33,000	33,000
9 x 19	17.5	348,000	33,000	35,000	37,200	37,200	37,800
9 x 20	18.5	389,000	36,000	38,000	40,000	41,600	41,800
9 x 21	19.5	433,000	37,600	41,400	42,400	45,000	45,600
9 x 22	20.5	478,000	41,800	44,400	46,600	48,800	50,000
9 x 23	21.5	526,000	44,600	47,600	50,000	52,500	55,000
9 x 24	22.5	575,000	47,600	50,600	53,600	56,400	58,800
9 x 25	23.5	628,000	50,500	54,000	57,400	59,800	62,800
9 x 26	24.5	683,000	53,000	57,400	60,600	64,000	66,600
9 x 27	25.5	750,000	56,200	60,600	64,400	68,000	71,200
9 x 28	26.5	798,000	59,200	63,800	68,200	72,000	75,400
9 x 29	27.5	362,000	62,200	66,000	72,000	76,000	79,600
9 x 30	28.5	924,000	65,000	70,400	75,500	80,000	84,000
9 x 31	29.5	988,000	68,000	73,500	79,500	84,500	88,000
9 x 32	30.5	1,058,000	71,000	76,700	84,400	88,500	92,600
9 x 33	31.5	1,122,000	73,800	80,000	86,400	92,000	97,400
9 x 34	32.5	1,201,000	76,800	83,000	89,500	94,200	101,500
9 x 35	33.5	1,420,000	79,800	86,200	93,800	99,400	106,000
9 x 36	34.5	1,500,000	83,000	91,800	96,500	104,000	120,000

Tee Beam MR = $M - \frac{ds}{2} \times C$ B.ds.a

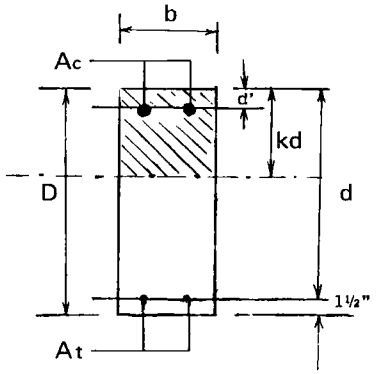
Rectangular beam MR = ½n ½ n_1 a_1 cb_2 d^2

矩形樑的設計 RECTANGULAR BEAMS

f_s = 18,000#/□" f_c = 1,000 #/□"
m = 15
k = 0.455
j = 0.848
Qc= 193.0
r = 0.0126

For Checking
k = 2rm + $(rm)^2$ − rm
r = At/bd

ALLOWABLE SHEAR STRESS = 100 #/□"



SECTION b x D	EFFECTIVE DEPTH d	RESISTING MOMENT	AREA OF TENSILE STEEL	SHEAR CONC CAN TAKE	SPACING FOR 3/8" ø s.s. (IN)	COMPRESSION STEEL	
						d' = 1½"	d' = 2½"
9" x 12"	10.5	191,500"#	M/160,200"#	8,020#	35,300/V	dM/86,500	dM/53,400
9" x 13"	11.5	230,000	175,500	8,780	38,600	99,800	65,900
9" x 14"	12.5	271,500	190,800	9,540	42,000	113,400	78,600
9" x 15"	13.5	317,000	206,000	10,300	45,300	127,000	91,500
9" x 16"	14.5	365,000	221,000	11,070	48,700	140,500	104,200
9" x 17"	15.5	417,500	236,700	11,820	52,100	154,300	117,500
9" x 18"	16.5	473,000	252,000	12,600	55,400	168,000	130,700
9" x 19"	17.5	532,500	267,200	13,360	58,800	181,700	144,000
9" x 20"	18.5	595,000	282,500	14,120	62,100	195,700	157,400
9" x 21"	19.5	661,000	297,500	14,880	65,500	209,500	171,000
9" x 22"	20.5	731,500	313,000	15,650	68,900	223,000	184,500
9" x 23"	21.5	804,000	328,500	16,420	72,200	237,000	198,000
9" x 24"	22.5	882,000	344,000	17,200	75,600	251,000	212,000
9" x 25"	23.5	961,000	359,000	17,950	79,000	265,000	225,000
9" x 26"	24.5	1,045,000	374,500	18,720	82,400	279,000	239,000
9" x 27"	25.5	1,130,000	389,500	19,470	85,700	293,000	253,000
9" x 28"	26.5	1,222,000	405,000	20,250	89,000	307,000	266,000
9" x 29"	27.5	1,316,000	420,000	21,000	92,500	320,000	280,000
9" x 30"	28.5	1,413,000	435,000	21,750	95,800	334,500	294,000
9" x 31"	29.5	1,514,000	451,000	22,500	99,100	348,000	307,000
9" x 32"	30.5	1,620,000	466,000	23,300	102,500	362,000	321,000
9" x 33"	31.5	1,726,000	481,000	24,050	105,800	376,000	335,000
9" x 34"	32.5	1,837,000	496,000	24,800	109,200	390,000	349,000
9" x 35"	33.5	1,952,000	512,000	25,600	112,500	404,000	363,000
9" x 36"	34.5	2,070,000	527,000	26,340	115,900	418,000	377,000

矩形樑的設計 RECTANGULAR BEAMS (PER. IN. WIDTH)

t = 20,000 psi c = 1,000 psi $K = n_1$ = 0.428 $j = a_1$ = 0.857

Q = 184 Qc = 406

DEPTH	RMc (in. lb.) Ac = 0	At	Ac	RMc (in. lb.) Ac = At	Ac = At	S
9"	10,180	129,000	44,800	22,900	120,000	6.44
10"	13,300	146,000	58,600	29,500	140,000	7.40
11"	16,600	163,000	70,600	36,950	160,000	8.14
12"	20,100	180,500	84,000	44,900	180,000	9.00
13"	24,200	198,000	97,000	63,000	200,000	9.85
14"	28,600	215,000	101,400	74,000	220,000	10.72
15"	33,500	232,000	124,800	85,000	240,000	11.58
16"	38,500	249,000	138,000	97,000	260,000	12.42
17"	44,100	266,500	152,200	110,500	280,000	13.30
18"	49,800	293,800	165,500	124,000	300,000	14.15
19"	56,100	300,500	184,200	139,000	320,000	15.00
20"	62,500	318,000	193,000	154,000	340,000	15.88
21"	66,980	336,000	205,500	170,000	360,000	16.70
22"	77,200	353,000	220,000	188,000	380,000	17.55
23"	85,000	370,000	234,000	205,000	400,000	18.40
24"	93,000	386,000	248,500	224,000	420,000	19.30
25"	101,500	404,000	262,000	244,000	440,000	20.10
26"	110,000	422,000	274,000	264,000	458,000	21.00
27"	119,000	439,000	289,000	285,000	482,000	21.80
28"	128,300	455,000	304,000	306,000	500,000	22.70
29"	138,200	474,000	318,000	330,000	520,000	23.60
30"	148,200	490,000	332,000	353,000	542,500	24.42
31"	159,800	506,000	346,000	379,000	560,000	25.30
32"	170,000	525,000	359,000	402,500	580,000	26.10
33"	182,000	542,000	372,500	429,000	600,000	27.00
34"	194,000	560,000	396,000	455,000	620,000	27.90
35"	206,000	576,000	400,000	484,000	640,000	28.70
36"	219,000	594,000	415,000	505,000	660,000	29.60

矩形樑的設計 RECTANGULAR BEAMS

$$d = 0.074\sqrt{\frac{M\ (\text{in. lb.})}{b}}$$

Q = 184 Qc= 406

c = 1,000 psi $K = n_1 = 0.428$
f = 20,000 psi $j = a_1 = 0.857$

SECTION	RMc (in. lb.) Ac = 0	At	Ac	RMc (Ac = At) (in. lb.)	Ac = At	S
9" x 9"	92,500	129,000	44,800	205,000	120,000	57.8
9" x 10"	119,000	146,000	58,600	264,000	140,000	65.5
9" x 11"	148,000	163,000	70,600	330,000	160,000	73.2
9" x 12"	182,000	180,500	84,000	402,000	180,000	81.0
9" x 13"	217,000	198,000	97,000	482,000	200,000	88.9
9" x 14"	256,000	215,000	101,400	570,000	220,000	96.4
9" x 15"	290,000	232,000	124,800	665,000	240,000	104.0
9" x 16"	346,000	249,000	138,000	770,000	260,000	113.5
9" x 17"	396,000	266,500	152,200	875,000	280,000	119.5
9" x 18"	450,000	293,800	165,500	998,000	300,000	127.0
9" x 19"	500,500	300,500	184,200	1,120,000	320,000	135.0
9" x 20"	565,000	318,000	193,000	1,245,000	340,000	142.5
9" x 21"	625,000	336,000	205,500	1,380,000	360,000	150.5
9" x 22"	690,000	353,000	220,000	1,540,000	380,000	158.0
9" x 23"	760,000	370,000	234,000	1,692,000	400,000	165.8
9" x 24"	838,000	386,000	248,500	1,842,000	420,000	173.8
9" x 25"	915,000	404,000	262,000	2,020,000	440,000	181.0
9" x 26"	990,000	422,000	274,000	2,190,000	458,000	189.0
9" x 27"	1,070,000	439,000	289,000	2,360,000	482,000	196.5
9" x 28"	1,160,000	455,000	304,000	2,560,000	500,000	204.0
9" x 29"	1,250,000	474,000	318,000	2,750,000	520,000	212.0
9" x 30"	1,340,000	490,000	332,000	2,955,000	542,500	220.0
9" x 31"	1,430,000	506,000	346,000	3,160,000	560,000	227.8
9" x 32"	1,530,000	525,000	359,000	3,400,000	580,000	235.0
9" x 33"	1,630,000	542,000	372,500	3,625,000	600,000	242.5
9" x 34"	1,740,000	560,000	396,000	3,850,000	620,000	250.5
9" x 35"	1,850,000	576,000	400,000	4,100,000	640,000	258.0
9" x 36"	1,960,000	594,000	415,000	4,360,000	660,000	266.0

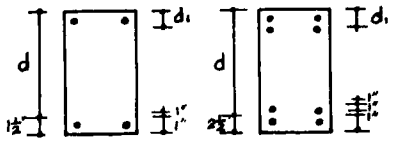
矩形樑的設計　DESIGN OF R.C.C. BEAM

fs = 30,000 psi　　fc = 1,000 psi　　m = 15　　(ONE LAYER) $f' = \frac{n - 1.5}{n}$ fc

fsc = 25,000 psi　　$k = n_1 = 0.333$　　$j = a_1 = 0.889$　　(TWO LAYER) $f' = \frac{n - 2.5}{n}$ fc

v = 100 psi　　$RMc = 148\ bd^2$　　C = 148

$At = \frac{B.M.}{fs\ a_1\ d}$　　$Ac = \frac{B.M. - RMc}{f'(m-1)(d-d_1)}$



OVER ALL DEPTH (IN)	EFFECT-IVE DEPTH (IN)	At (IN)²	Ac (IN)²		Rc b = 9" (IN–K)	MAX. SHEAR (LBS)	Rc PER IN. (IN–LB) (Ds = 4")	Rc PER IN. (IN–LB) (DS = 5")
			ONE LAYER	TWO LAYER				
10	8.5	227.0	48		96.2	6,800	10,760	10,700
11	9.5	253.0	59		120.0	7,600	13,350	13,350
12	10.5	280.0	72	23	147.0	8,400	16,320	16,320
13	11.5	307.0	85	36	176.2	9,200	19,600	19,600
14	12.5	333.0	99	49	208.0	10,000	21,800	23,100
15	13.5	360.0	112	61	243.0	10,800	25,500	27,000
16	14.5	387.0	125	74	280.0	11,600	29,300	31,100
17	15.5	414.0	139	87	320.0	12,380	33,000	33,500
18	16.5	440.0	153	100	363.0	13,200	36,800	38,000
19	17.5	466.0	166	114	408.0	14,000	40,600	42,700
20	18.5	494.0	180	127	456.0	14,800	44,500	47,400
21	19.5	520.0	194	141	500.0	15,600	48,400	52,100
22	20.5	546.0	208	154	560.0	16,400	52,200	56,600
23	21.5	574.0	222	168	615.0	17,200	56,000	61,600
24	22.5	600.0	235	182	675.0	18,000	59,900	66,300
25	23.5	626.0	249	195	736.0	18,700	63,900	71,300
26	24.5	654.0	263	208	800.0	19,600	67,900	76,100
27	25.5	680.0	277	223	866.0	20,400	71,800	81,100
28	26.5	706.0	290	236	935.0	21,200	75,800	85,800
29	27.5	734.0	304	250	1010.0	22,000	79,600	90,600
30	28.5	760.0	318	264	1082.0	22,800	83,600	95,600
31	29.5	786.0	332	278	1158.0	23,600	87,400	100,500
32	30.5	814.0	345	292	1240.0	24,400	91,400	105,100
33	31.5	840.0	360	305	1320.0	25,200	95,200	110,100
34	32.5	866.0	374	318	1408.0	26,000	99,200	115,100
35	33.5	894.0	388	332	1495.0	26,900	103,400	120,100
36	34.5	920.0	402	346	1590.0	27,600	107,400	125,100

NOTES: (1) An effective diameter for bars exceed 7/8 in.

(2) The permissible compressive stress in Bars are 25,000 psi.

(3) The permissible stresses in concrete and in Bars are increased