

DETAIL A
NONREINFORCED

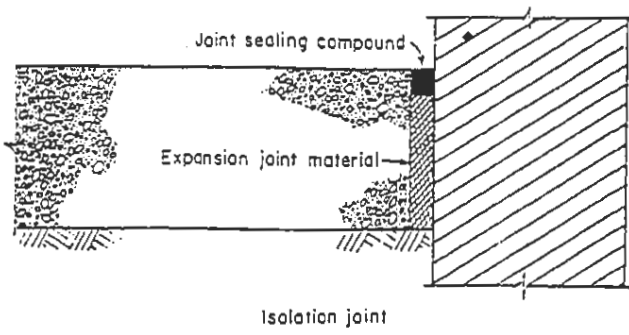


Fig. 9-12. Isolation joints permit horizontal and vertical movements between abutting faces of the slab and fixed parts of a structure.

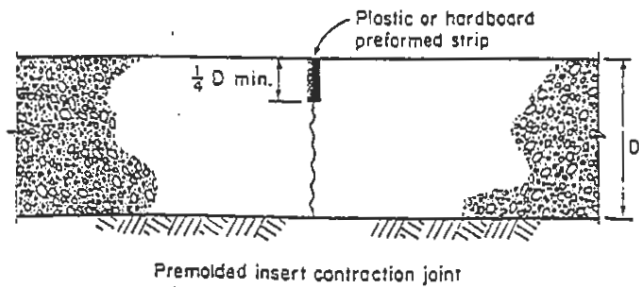
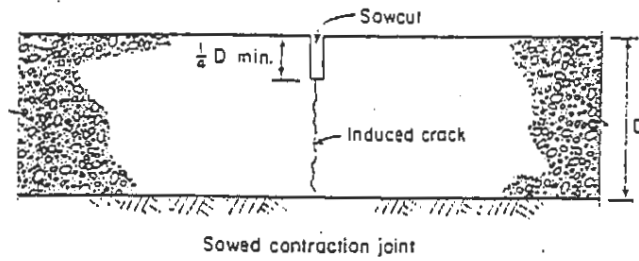


Fig. 9-13. Contraction joints provide for horizontal movement in the plane of a slab or wall and induce controlled cracking caused by drying shrinkage.

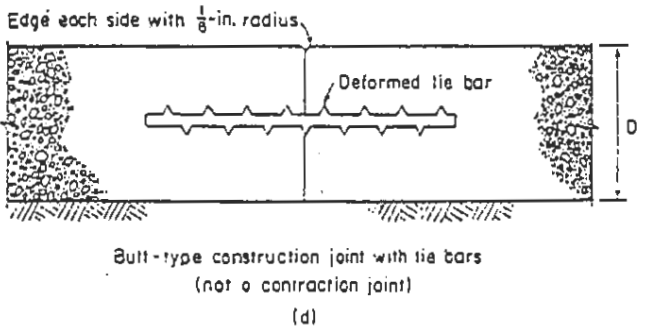
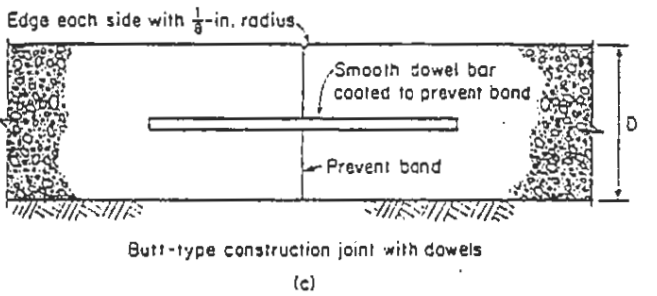
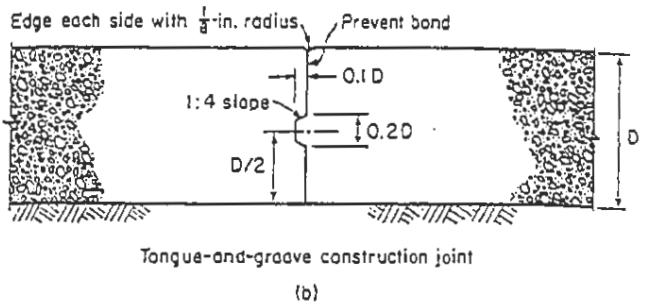
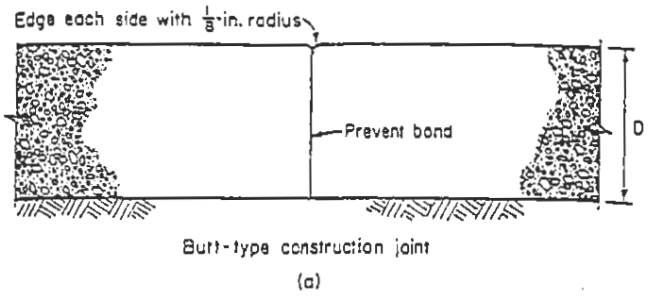


Fig. 9-15. Construction joints are stopping places in the process of construction. Construction-joint types a, b, and c are also used as contraction joints.

Slab Thickness	Dowel Diameter			Minimum Embedment ACI 330	Dowel Length			Spacing ACI & ACI 330 302
	ACI 330	ACI 302	TMs		ACI 330	ACI 302	TMs	
5	5/8	3/4	3/4	5	12	16	15	12
6	3/4	3/4	3/4	6	14	16	15	12
7	7/8	1	3/4	6	14	18	15	12
8	1	1	1	6	14	18	16	12
9	1 1/8	1 1/4	1	7	16	18	16	12
10	1 1/4	1 1/4	1	7 1/2	18	18	16	12
11	1 3/8	1 1/4	1	8	18	18	16	12
12	1 1/2	—	1 1/4	9	20	18	18	12

NOTE: Only ACI 330 and 302 recommend spacings of 12 inches. The Army/Air Force technical manual (TM) recommends a variable spacing from 9 inches to 24 inches depending upon the type of joint. Only ACI 330 recommends a minimum embedment.

Table 29 Comparison of recommended dimensions and spacing for dowels (all values in inches).

Slab thickness, inches	Slump 4-6 inches		Slump < 4 in.
	MCA < 3/4 in.	MCA > 3/4 in.	
5	10	13	15
6	12	15	18
7	14	18	21
8	16	20	24
9	18	23	27
10	20	25	30

Table 30 PCA recommendation for joint spacing (feet) in plain concrete slabs.

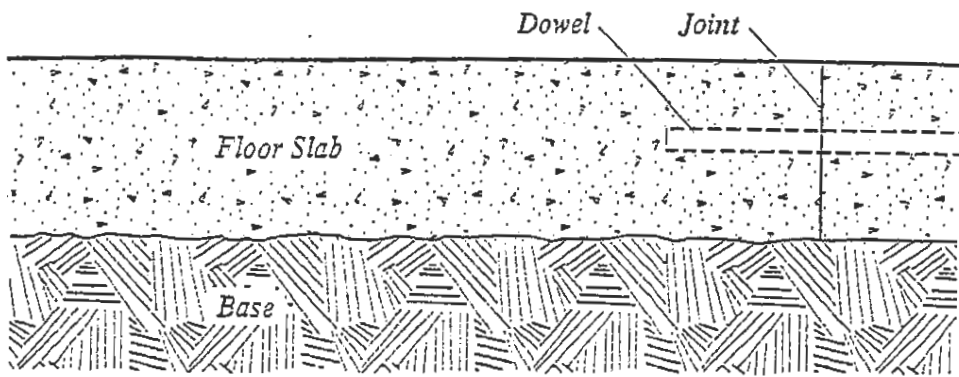


Figure 8 Plain concrete slab contains no reinforcement but may be strengthened at the joints.

Commentary:
 The Portland Cement Association recommends joint spacings in feet equal to from 2 to 3 times the slab thickness in inches (Reference 6). This is conservative, but relatively safe.

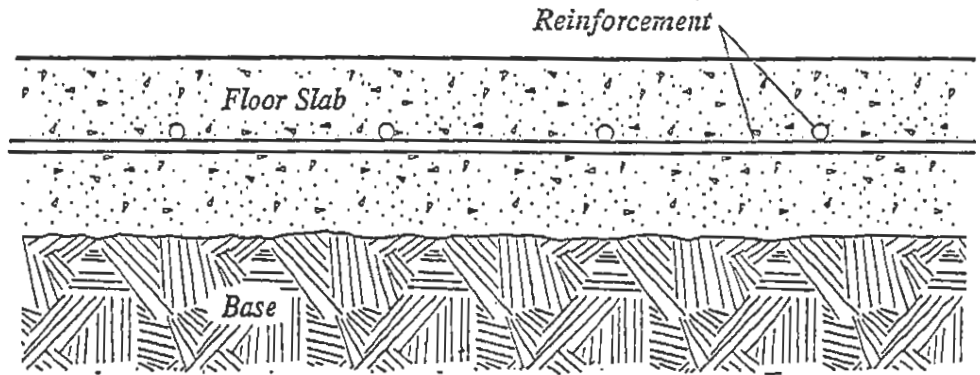


Figure 9 Type B slab with shrinkage control reinforcement.

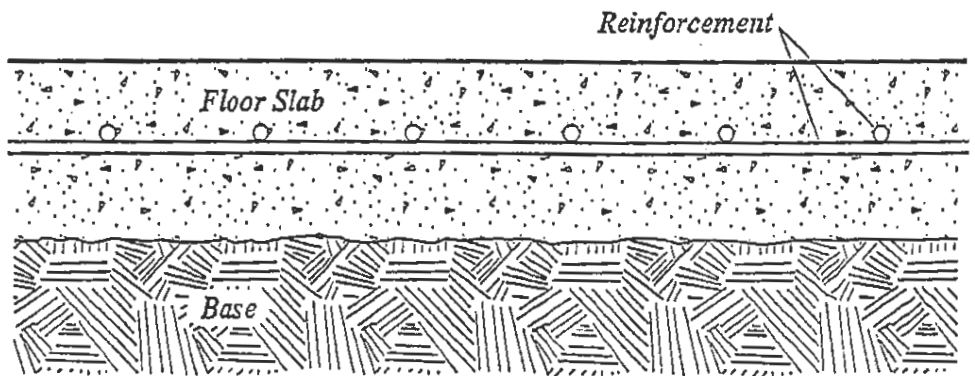
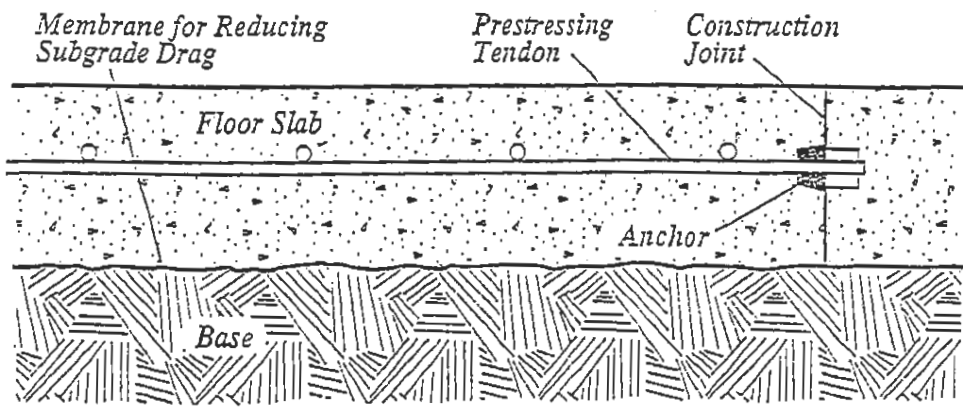


Figure 10 Shrinkage-compensating concrete slab must contain reinforcement as recommended by ACI 223.



Commentary:
 With post-tensioned slabs, one or two layers of polyethylene sheeting, perforated or non-perforated, are often used for reducing subgrade drag.

Figure 11 Slab post-tensioned for crack control.

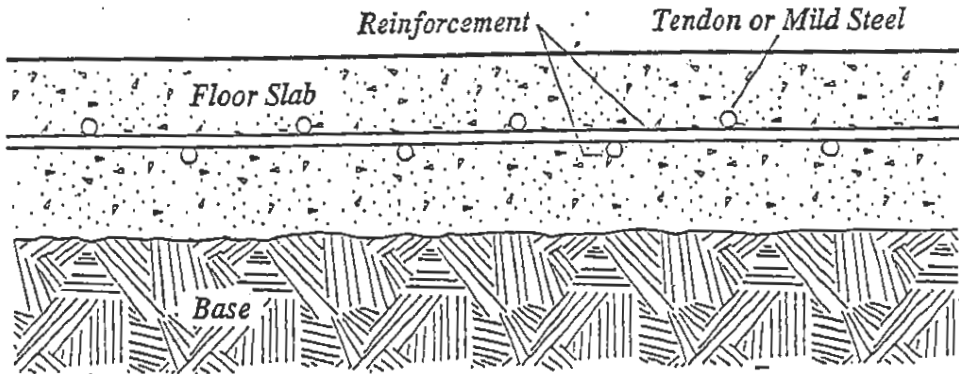


Figure 12 The lightly reinforced structural slab (Type E) may be uniformly thick or ribbed for stiffness and may be reinforced with bars, post-tensioning tendons, or both.

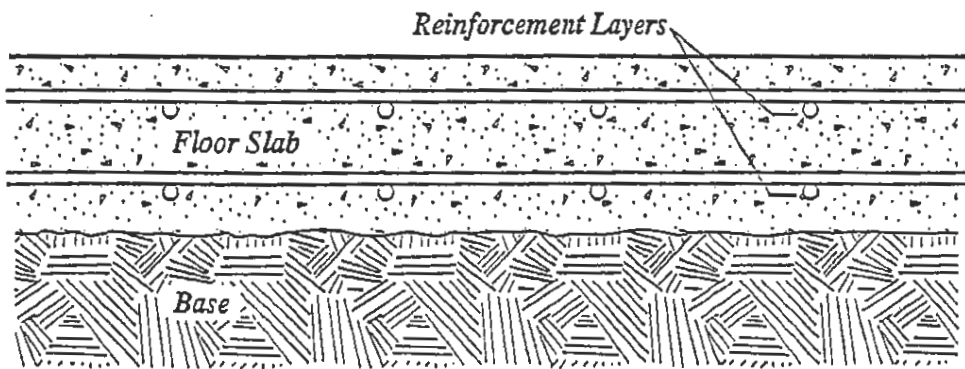


Figure 13 Structurally reinforced slab has one or two layers of reinforcement, either bars or welded wire fabric.

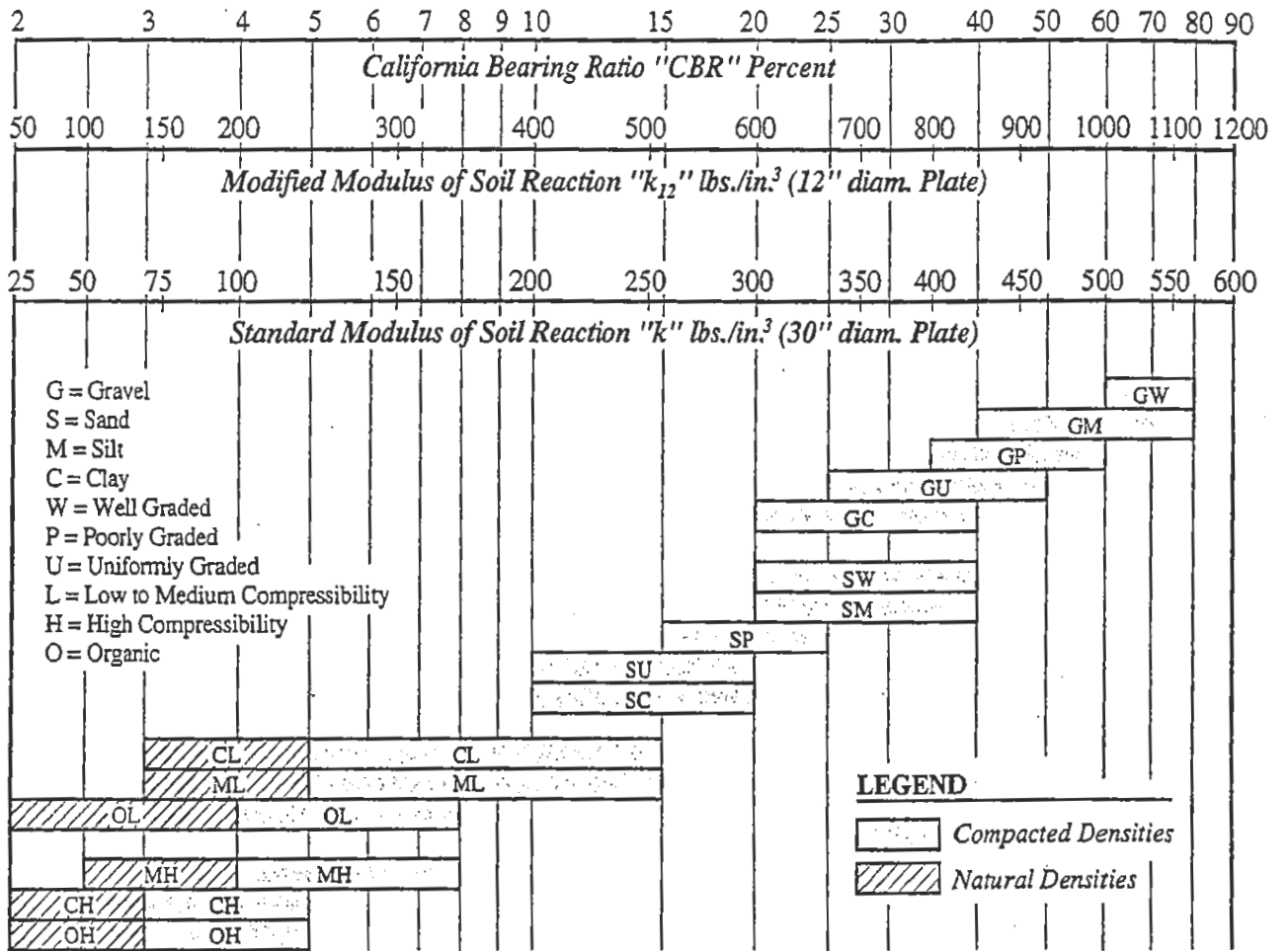
Table 2.1—Slab types with design methods suitable for each

TYPE OF SLAB CONSTRUCTION	DESIGN METHODS					
	PCA	WRI	COE	PTI	ACI 223	
TYPE A, PLAIN CONCRETE, no reinforcement	■	■	■			Thickness selection
	■		■			Related details
TYPE B, REINFORCED for shrinkage and temperature	■	■	■			Thickness selection
	■		■			Related details
TYPE C, SHRINKAGE- COMPENSATING CONCRETE with shrinkage reinforcement	■	■	■			Thickness selection
					■	Related details
TYPE D, POST-TENSIONED for crack control	■	■	■	■		Thickness selection
				■		Related details
TYPE E, POST-TENSIONED and/or reinforced, with active prestress	■	■		■		Thickness selection
				■		Related details
TYPE F, REINFORCED for structural action	■	■	■			Thickness selection
		■	■			Related details

2.4—Design methods

2.4.1 *Introduction*—Five basic slab design methods are discussed in this report:

- The Portland Cement Association (PCA) method⁸
- The Wire Reinforcement Institute (WRI) method⁹
- The The United States Army Corps of Engineers (COE) method¹⁰
- The Post-Tensioning Institute (PTI) method¹¹
- The shrinkage-compensating concrete method (ACI 223)



NOTE: Comparison of soil type to "k" particularly in the "L" and "H" Groups, should generally be made in the lower range of the soil type.

Figure A.2 Interrelationships of soil classifications and strength criteria, from Reference 8.

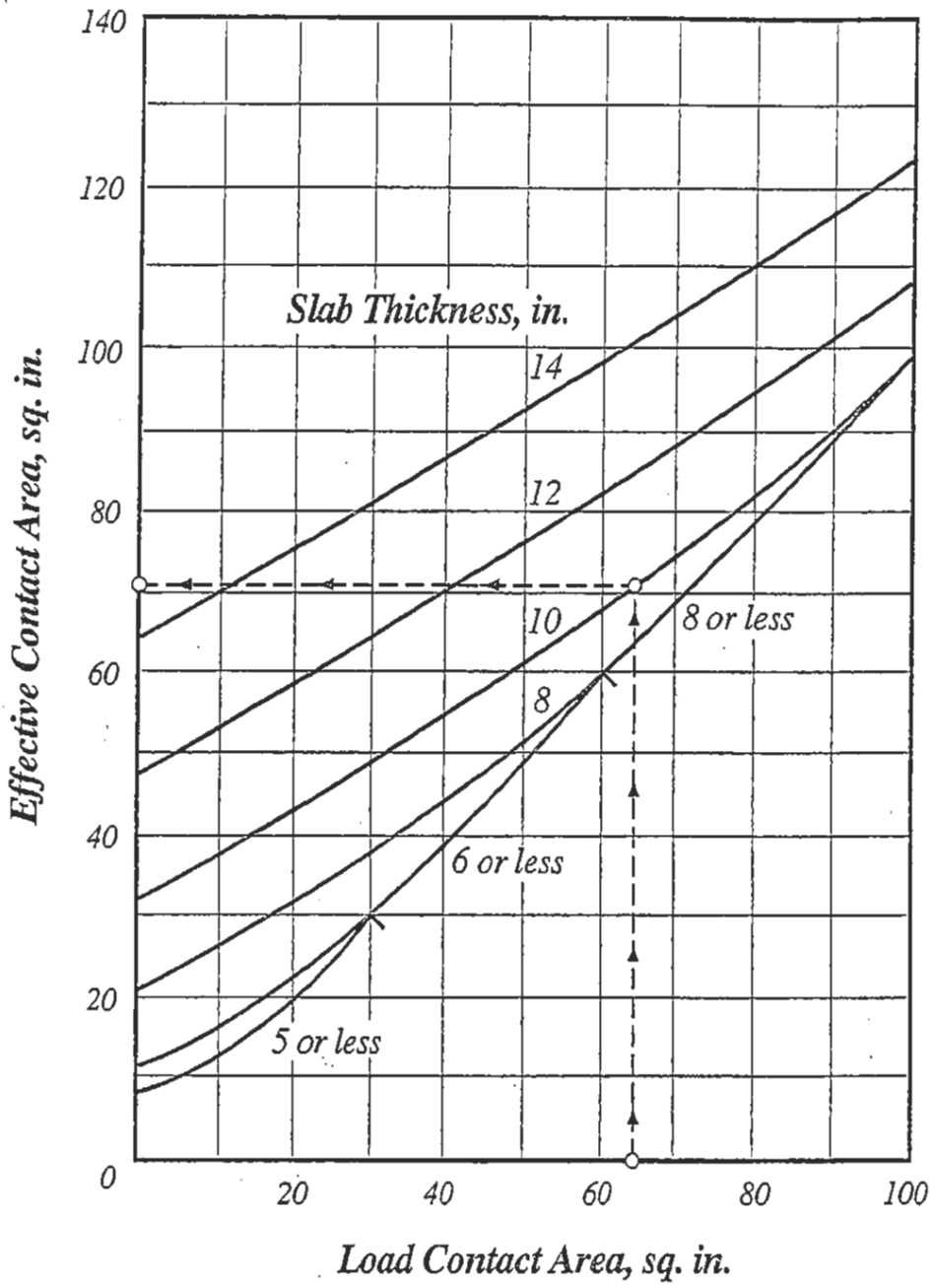


Figure A.8 PCA chart for determining effective wheel contact area for concrete slabs thicker than 8 inches.

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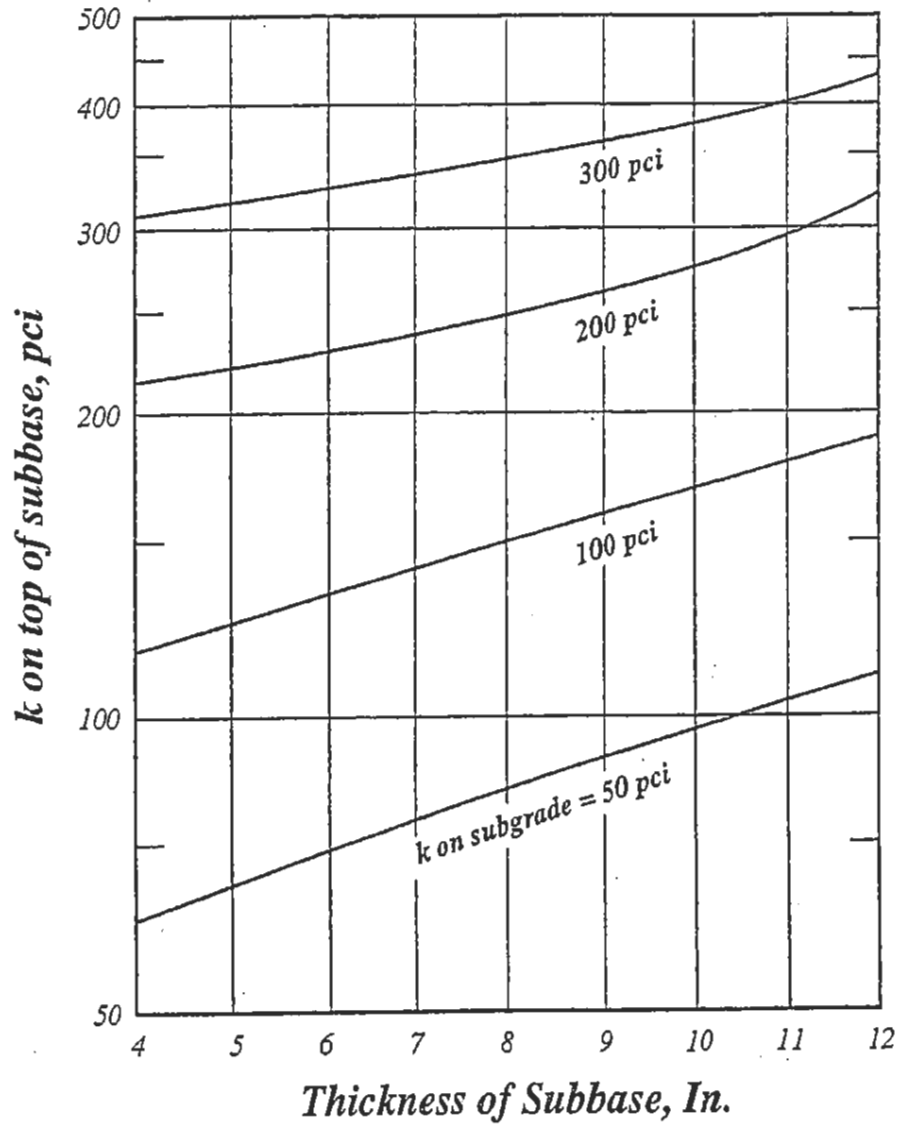
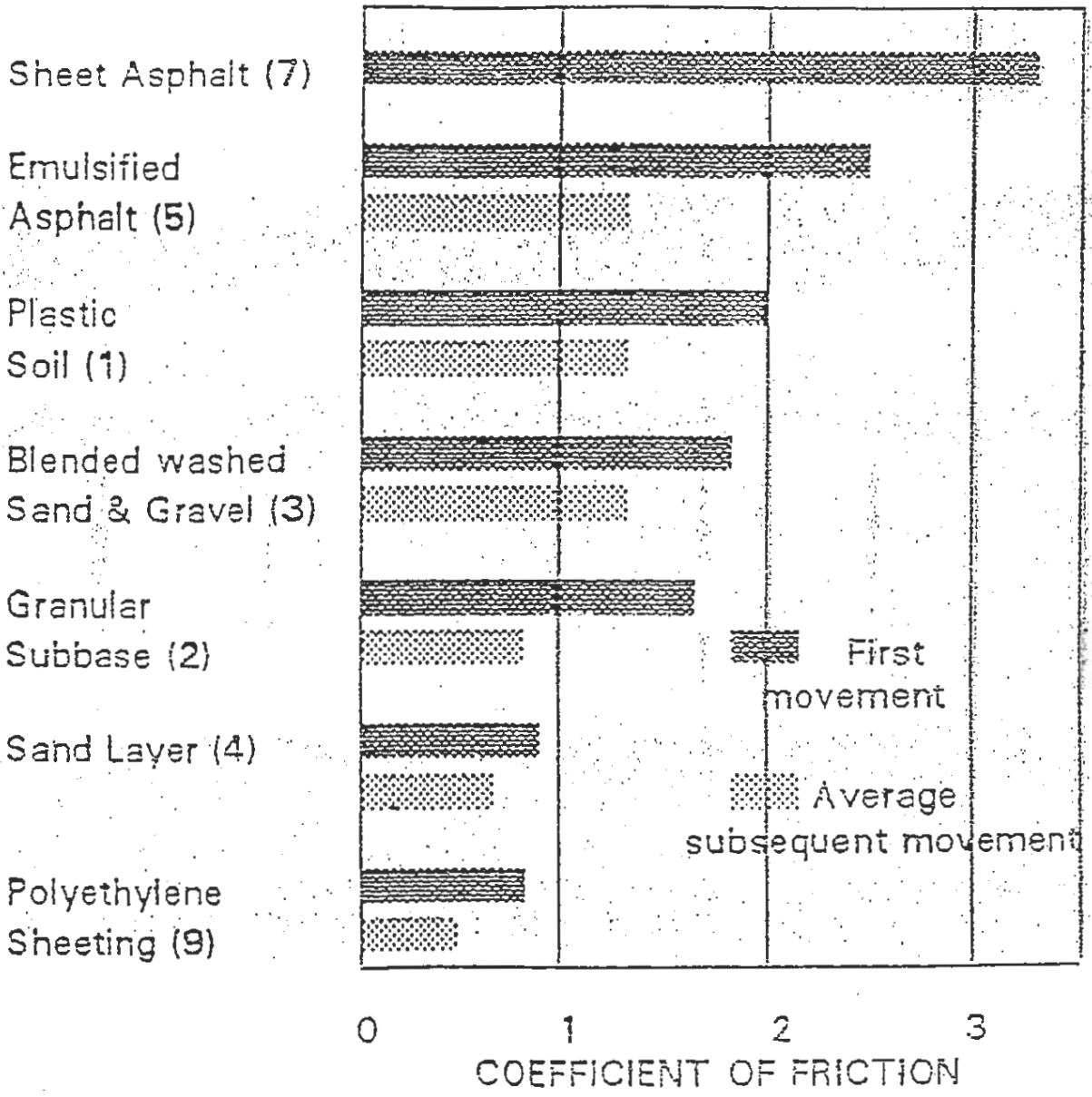


Figure A.10 PCA chart for determining effect of granular subbase thickness on k value, from Reference 14.



A.3—Design Charts from Portland Cement Association, Wire Reinforcement Institute, Corps of Engineers, and American Concrete Institute

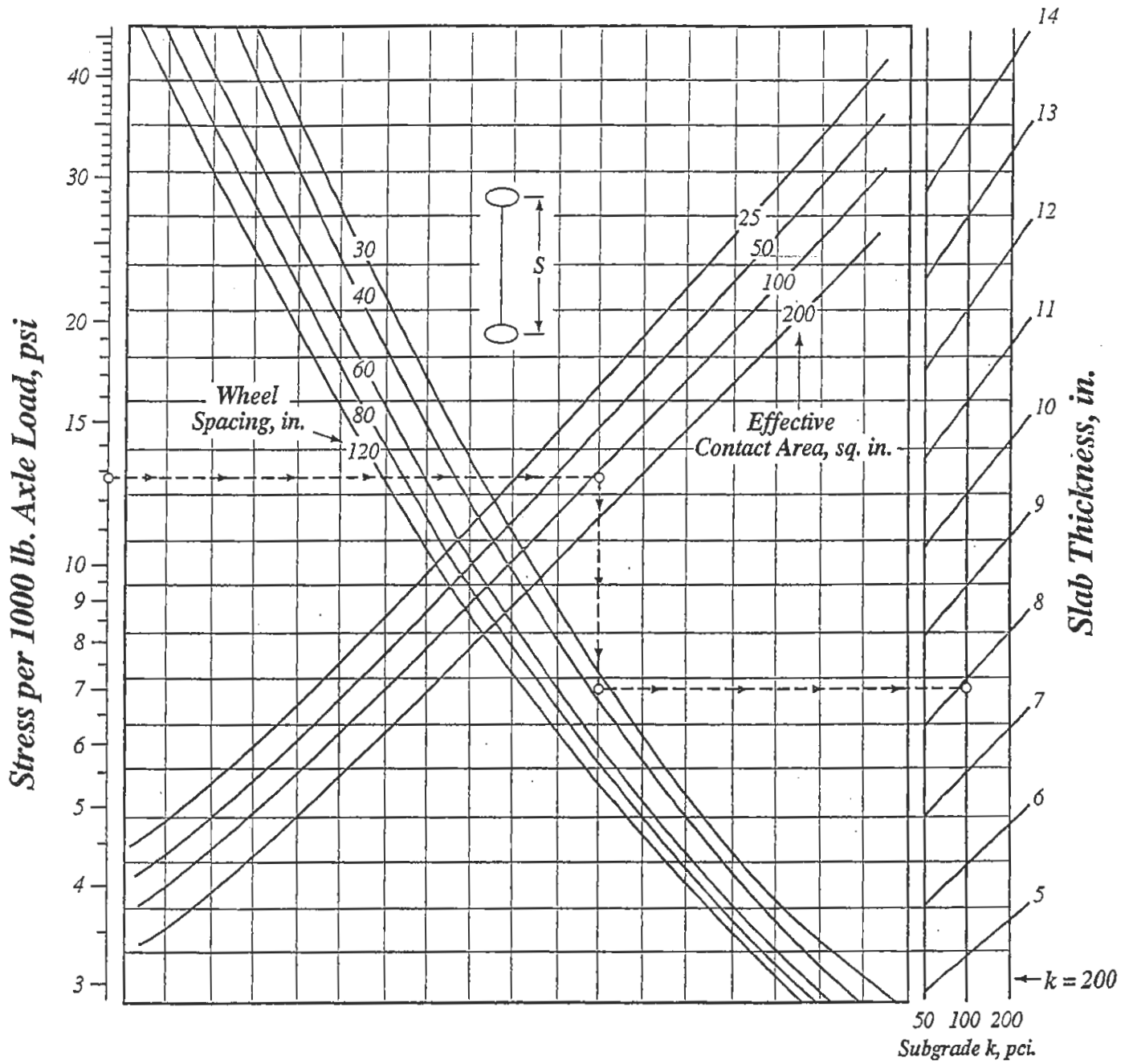


Figure A.7 PCA design chart for selection of slab thickness for single axle loading.

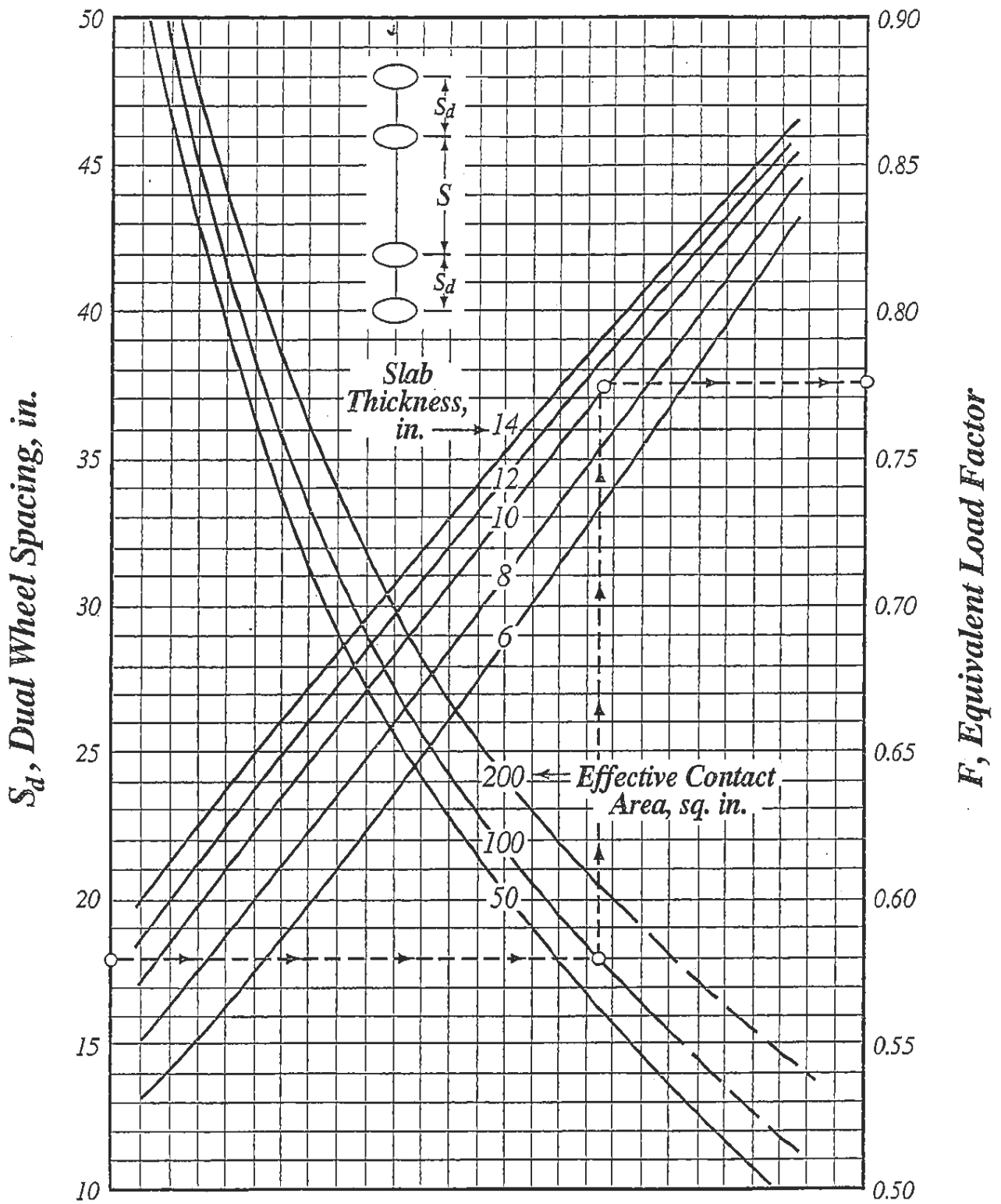


Figure A.9 Reduction factor used with PCA charts when designing for dual-wheel loads.

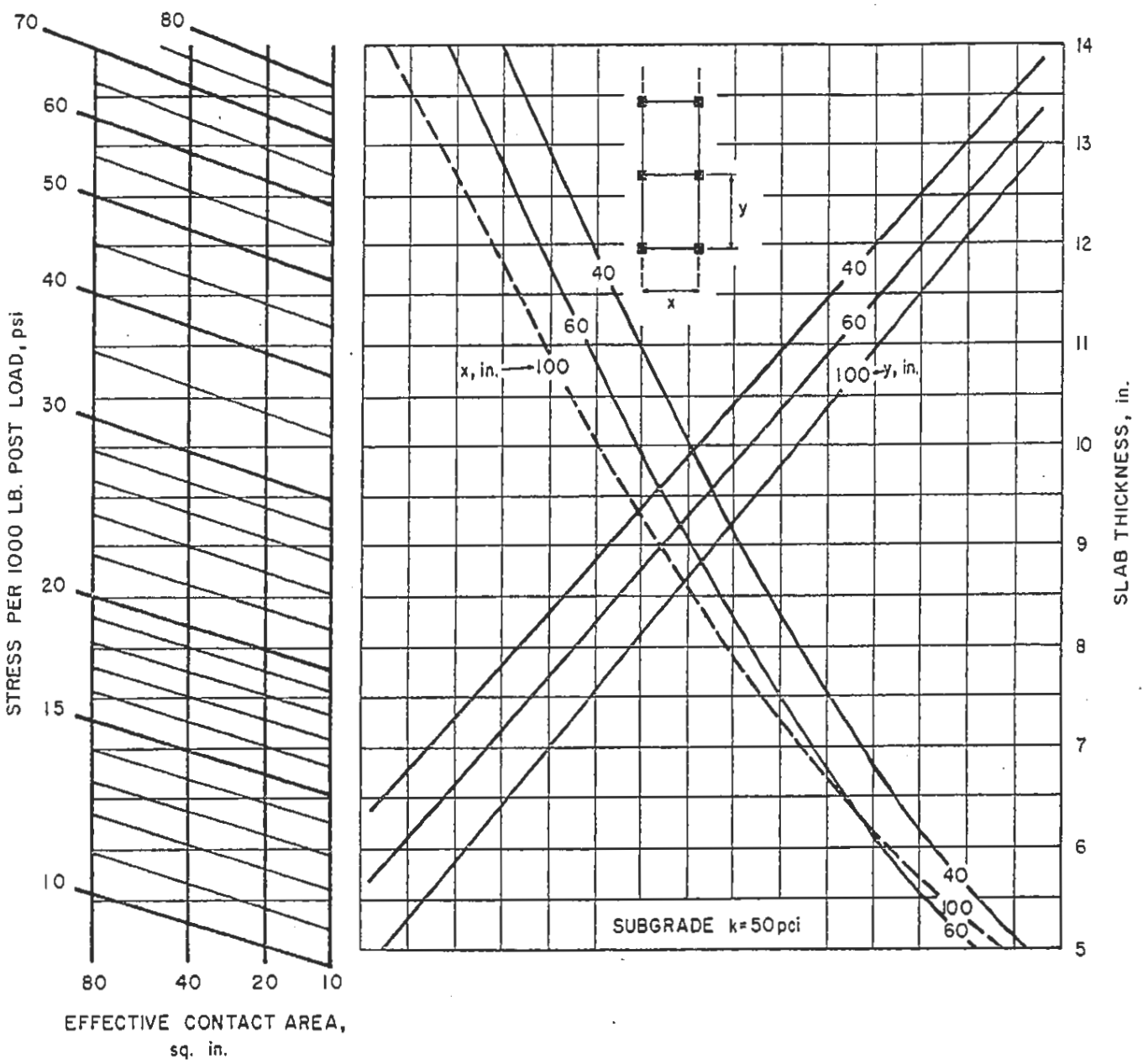


Figure A.17 PCA chart for slab thickness selection when using post loading with subgrade $k = 50 \text{ pci}$.

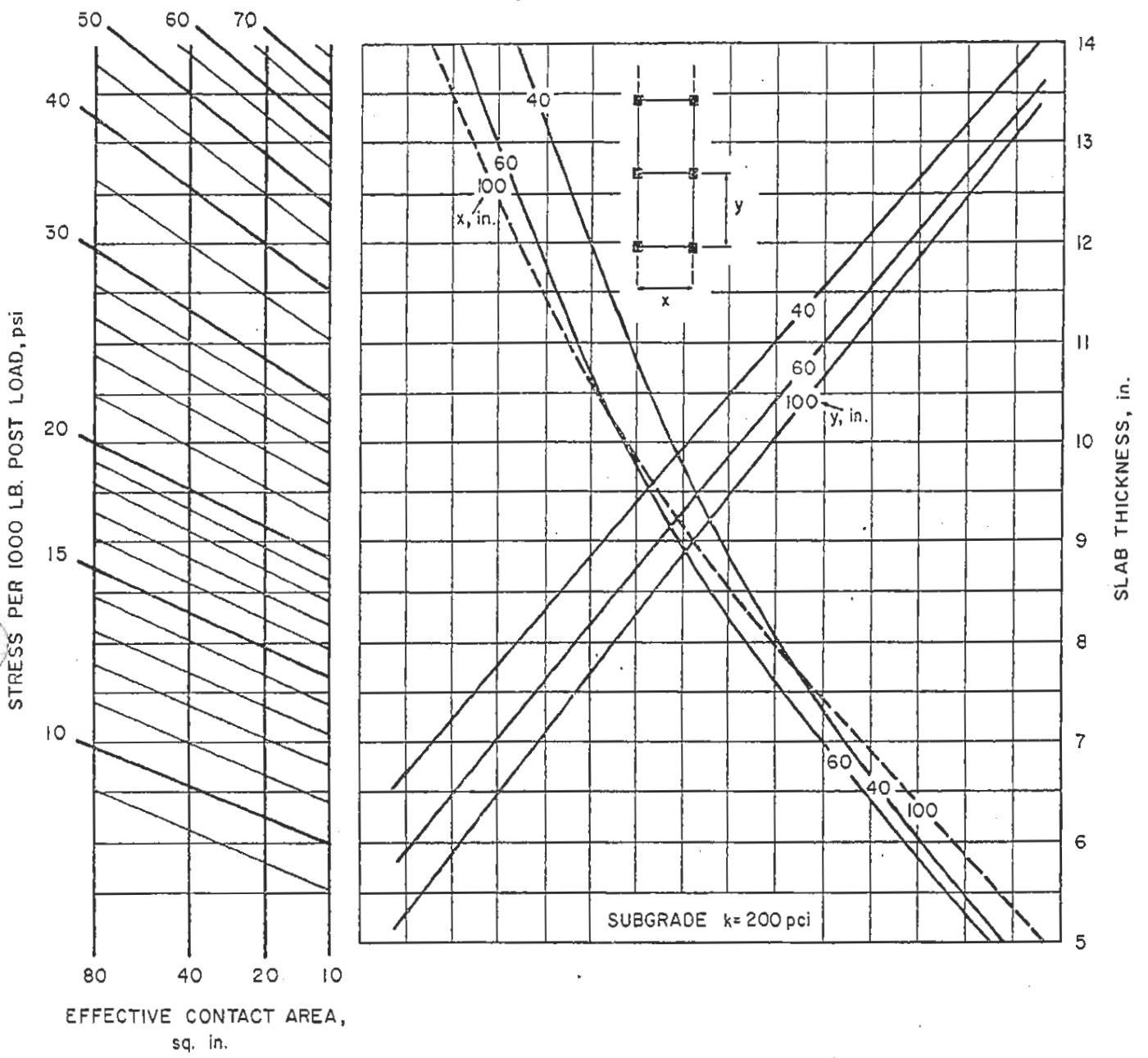


Figure A.19 PCA chart for slab thickness selection when using post loading with subgrade $k = 200$ pci.

Slab thickness, in.	Working stress, psi	Critical aisle width, ft. ⁽²⁾	Allowable load, psf							
			At critical aisle width	At other aisle widths						
				6-ft. aisle	8-ft. aisle	10-ft. aisle	12-ft. aisle	14-ft. aisle		
Subgrade $k = 50 \text{ pci}^{(1)}$										
5	300	5.6	610	615	670	815	1,050	1,215		
	350	5.6	710	715	785	950	1,225	1,420		
	400	5.6	815	820	895	1,085	1,400	1,620		
6	300	6.4	670	675	695	790	945	1,175		
	350	6.4	785	785	810	910	1,100	1,370		
	400	6.4	895	895	925	1,040	1,260	1,570		
8	300	8.0	770	800	770	800	880	1,010		
	350	8.0	900	935	900	935	1,025	1,180		
	400	8.0	1,025	1,070	1,025	1,065	1,175	1,350		
10	300	9.4	845	930	855	850	885	960		
	350	9.4	985	1,085	1,000	950	1,035	1,120		
	400	9.4	1,130	1,240	1,145	1,135	1,185	1,285		
12	300	10.8	915	1,065	955	915	925	965		
	350	10.8	1,065	1,240	1,115	1,070	1,080	1,125		
	400	10.8	1,220	1,420	1,270	1,220	1,230	1,290		
14	300	12.1	980	1,225	1,070	1,000	980	895		
	350	12.1	1,145	1,430	1,245	1,170	1,145	1,160		
	400	12.1	1,310	1,630	1,425	1,335	1,310	1,330		

Subgrade $k = 100 \text{ pci}^{(1)}$										
5	300	4.7	855	900	1,090	1,470	1,745	1,810		
	350	4.7	1,010	1,050	1,270	1,715	2,035	2,115		
	400	4.7	1,155	1,200	1,455	1,955	2,325	2,415		
6	300	5.4	950	955	1,065	1,320	1,700	1,925		
	350	5.4	1,105	1,115	1,245	1,540	1,985	2,245		
	400	5.4	1,265	1,275	1,420	1,760	2,270	2,565		
8	300	6.7	1,095	1,105	1,120	1,240	1,465	1,815		
	350	6.7	1,280	1,285	1,305	1,445	1,705	2,120		
	400	6.7	1,460	1,470	1,495	1,650	1,950	2,420		
10	300	7.9	1,215	1,265	1,215	1,270	1,395	1,610		
	350	7.9	1,420	1,475	1,420	1,480	1,630	1,880		
	400	7.9	1,625	1,645	1,625	1,690	1,860	2,150		
12	300	9.1	1,320	1,425	1,325	1,330	1,400	1,535		
	350	9.1	1,540	1,665	1,545	1,550	1,635	1,785		
	400	9.1	1,755	1,900	1,770	1,770	1,865	2,050		
14	300	10.2	1,405	1,590	1,445	1,405	1,435	1,525		
	350	10.2	1,640	1,855	1,685	1,640	1,675	1,775		
	400	10.2	1,875	2,120	1,925	1,875	1,915	2,030		

Subgrade $k = 200 \text{ pci}^{(1)}$										
5	300	4.0	1,225	1,400	1,930	2,450	2,565	2,520		
	350	4.0	1,425	1,630	2,255	2,860	2,990	2,940		
	400	4.0	1,630	1,865	2,675	3,270	3,420	3,360		
6	300	4.5	1,340	1,415	1,755	2,395	2,740	2,810		
	350	4.5	1,565	1,650	2,050	2,800	3,200	3,275		
	400	4.5	1,785	1,890	2,345	3,190	3,655	3,745		
8	300	5.6	1,550	1,550	1,695	2,045	2,635	3,070		
	350	5.6	1,810	1,810	1,980	2,385	3,075	3,580		
	400	5.6	2,065	2,070	2,615	2,730	3,515	4,085		
10	300	6.6	1,730	1,745	1,775	1,965	2,330	2,895		
	350	6.6	2,020	2,035	2,070	2,290	2,715	3,300		
	400	6.6	2,310	2,325	2,365	2,620	3,105	3,860		
12	300	7.6	1,890	1,945	1,895	1,995	2,230	2,610		
	350	7.6	2,205	2,270	2,210	2,330	2,600	3,045		
	400	7.6	2,520	2,595	2,525	2,660	2,972	3,480		
14	300	8.6	2,025	2,150	2,030	2,065	2,210	2,480		
	350	8.6	2,350	2,510	2,365	2,405	2,580	2,890		
	400	8.6	2,700	2,870	2,705	2,750	2,950	3,305		

¹ k of subgrade; disregard increase in k due to subbase.

²Critical aisle width equals 2.209 times radius of relative stiffness.

Assumed load width = 300 in.; allowable load varies only slightly for other load widths. Allowable stress = one-half flexural strength.

Table A.33 Allowable distributed loads, unjointed aisle (uniform load, fixed layout), from Reference 6.

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A.5 — Portland Cement Association and Concrete Reinforcing Steel Institute Tables

Slab thickness in.	Subgrade k^a pci	Allowable load, psf ^{***}			
		Concrete flexural strength, psi			
		550	600	650	700
5	50	535	585	635	685
	100	760	830	900	965
	200	1,075	1,175	1,270	1,370
6	50	535	640	695	750
	100	830	905	980	1,055
	200	1,175	1,280	1,390	1,495
8	50	680	740	800	865
	100	960	1,045	1,135	1,220
	200	1,355	1,480	1,603	1,725
10	50	760	830	895	965
	100	1,070	1,170	1,265	1,365
	200	1,515	1,655	1,790	1,930
12	50	830	905	980	1,055
	100	1,175	1,280	1,390	1,495
	200	1,660	1,810	1,965	2,115
14	50	895	980	1,060	1,140
	100	1,270	1,385	1,500	1,615
	200	1,795	1,960	2,120	2,285

^a k of subgrade: disregard increase in k due to subbase.

^{***} For allowable stress equal to 1/2 flexural strength.
Based on aisle and load widths giving maximum stress.

Table A.32 Allowable distributed load on slabs with unjointed aisles and variable layout, from Reference 6.

W&D Size No.		Wire Gauge No.	Nominal Diameter (In.)	Area (Sq. in.)	A_s - Square Inches per Lineal Foot				
Smooth	Deformed				Center to Center Spacing of Wires				
					4"	6"	12"	14"	16"
W20	D20		0.505	0.200	0.600	0.400	0.200	0.171	0.150
		7/0	0.490	0.189	0.567	0.378	0.189	0.162	0.142
W18	D18		0.479	0.180	0.540	0.360	0.180	0.154	0.135
		6/0	0.462	0.168	0.504	0.336	0.168	0.144	0.126
W16	D16		0.451	0.160	0.480	0.320	0.160	0.137	0.120
		5/0	0.431	0.146	0.438	0.292	0.146	0.125	0.110
W14	D14		0.422	0.140	0.420	0.280	0.140	0.120	0.105
		4/0	0.394	0.122	0.366	0.244	0.122	0.105	0.092
W12	D12		0.391	0.120	0.360	0.240	0.120	0.103	0.090
W11	D11		0.374	0.110	0.330	0.220	0.110	0.094	0.083
W10.5			0.366	0.105	0.315	0.210	0.105	0.090	0.079
		3/0	0.363	0.103	0.309	0.206	0.103	0.088	0.077
W10	D10		0.357	0.100	0.300	0.200	0.100	0.086	0.075
W9.5			0.348	0.095	0.285	0.190	0.095	0.081	0.071
W9	D9		0.338	0.090	0.270	0.180	0.090	0.077	0.068
		2/0	0.331	0.086	0.258	0.172	0.086	0.074	0.065
W8.5			0.329	0.085	0.255	0.170	0.085	0.073	0.064
W8	D8		0.319	0.080	0.240	0.160	0.080	0.069	0.060
W7.5			0.309	0.075	0.225	0.150	0.075	0.064	0.056
		1/0	0.307	0.074	0.222	0.148	0.074	0.063	0.056
W7	D7		0.299	0.070	0.210	0.140	0.070	0.060	0.053
W6.5			0.288	0.065	0.195	0.130	0.065	0.056	0.049
		1	0.283	0.063	0.189	0.126	0.063	0.054	0.047
W6	D6		0.276	0.060	0.180	0.120	0.060	0.051	0.045
W5.5			0.265	0.055	0.165	0.110	0.055	0.047	0.041
		2	0.263	0.054	0.162	0.108	0.054	0.046	0.041
W5	D5		0.252	0.050	0.150	0.100	0.050	0.043	0.038
		3	0.244	0.047	0.141	0.094	0.047	0.040	0.035
W4.5			0.239	0.045	0.135	0.090	0.045	0.039	0.034
W4	D4		0.226	0.040	0.120	0.080	0.040	0.034	0.030
W3.5			0.211	0.035	0.105	0.070	0.035	0.030	0.026
		5	0.207	0.034	0.102	0.068	0.034	0.029	0.025
W3			0.195	0.030	0.090	0.060	0.030	0.026	0.023
W2.9		6	0.192	0.029	0.087	0.058	0.029	0.025	0.022
W2.5		7	0.178	0.025	0.075	0.050	0.025	0.021	
W2.1		8	0.162	0.021	0.063	0.042	0.021		
W2			0.160	0.020	0.060	0.040	0.020		
		9	0.148	0.017	0.051	0.034			
W1.5			0.138	0.015	0.045	0.030			
W1.4		10	0.134	0.014	0.042	0.028			

Table 10 Wire size comparison and sectional areas of welded wire fabric. (American standard customary units)