پیوست

(در این بخش جداول، نمودارها و اشکالی که به پیوست رجوع داده شده‌اند به تفکیک فصل آمده است.)

لیست پیوست‌های فصل دوم

لیست پیوست‌های فصل سوم

لیست پیوست‌های فصل چهارم

لیست پیوست‌های فصل ششم

لیست پیوست‌های فصل نهم

لیست پیوست‌های فصل دهم

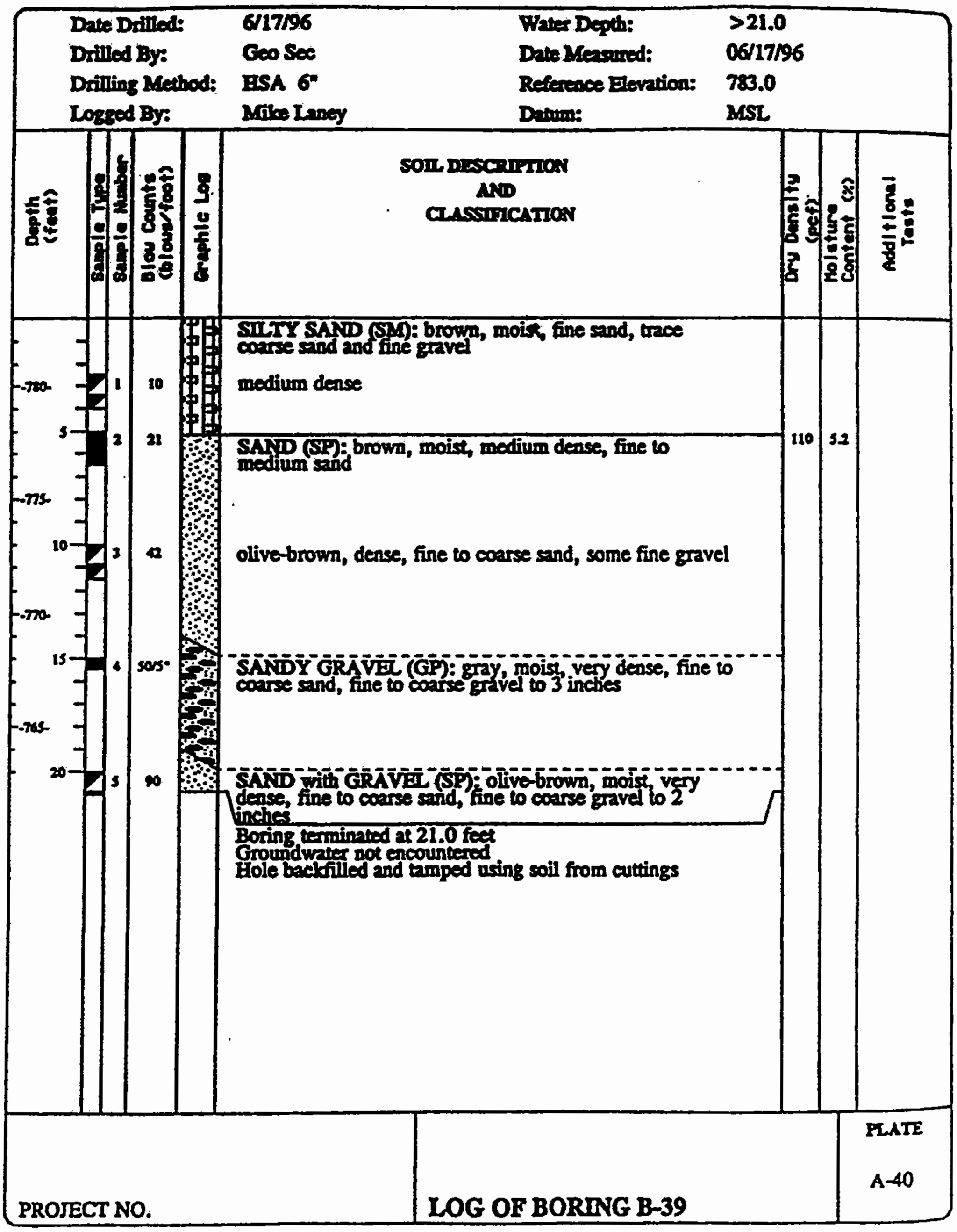
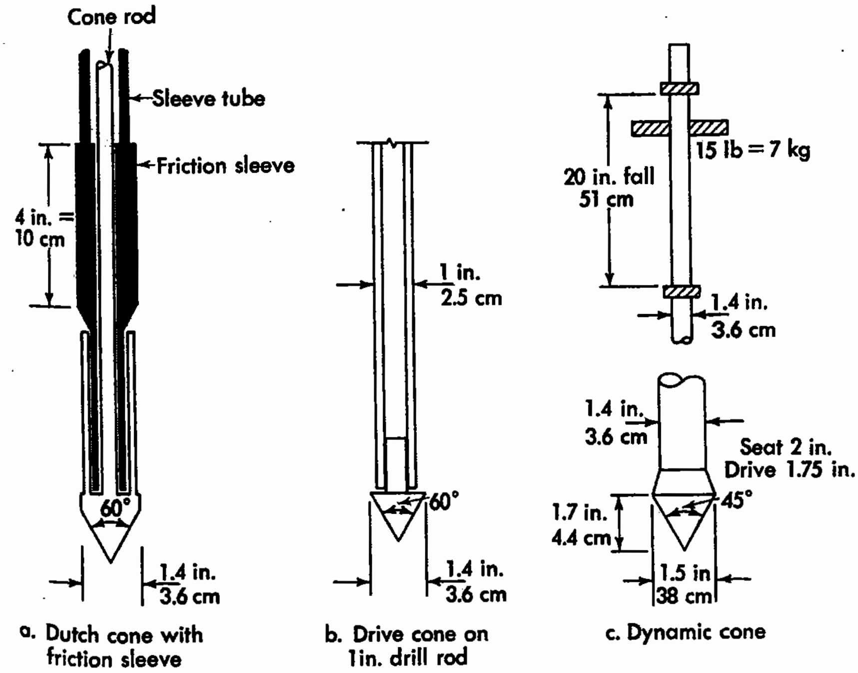


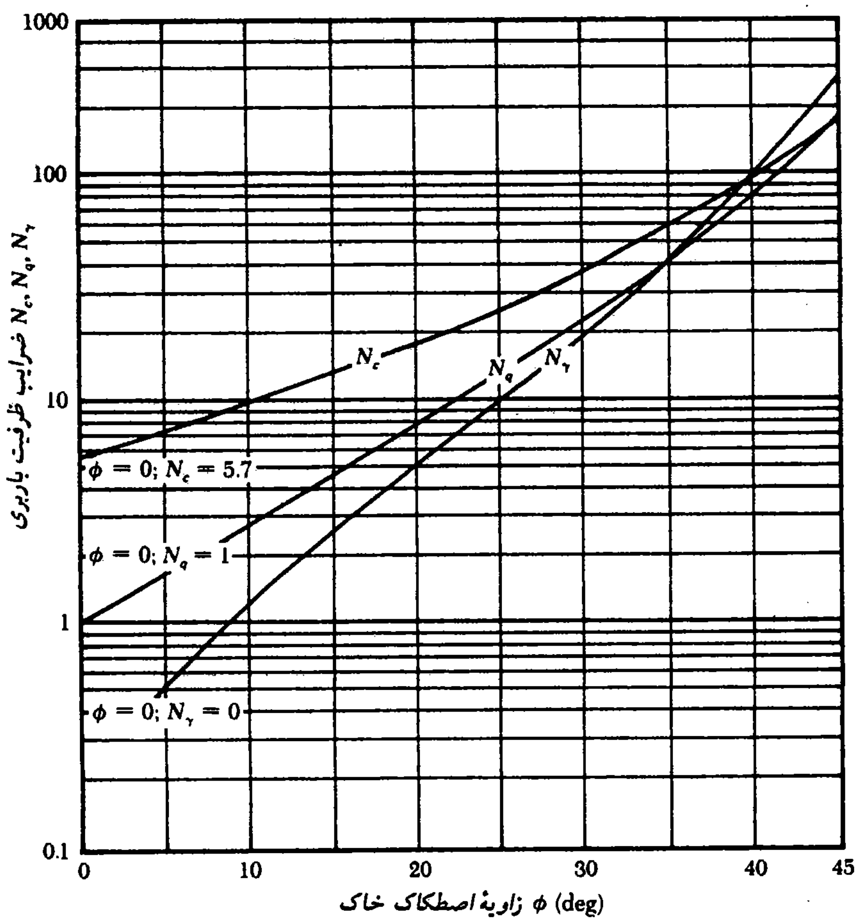
Figure 3.14 A boring log. Samples 2 and 4 were obtained using a heavy-wall sampler, and the corresponding blow counts are the number of hammer blows required to drive the sampler. Samples 1, 3, and 5 are standard penetration tests, and the corresponding blow counts are the N_{60} values, as discussed later in this chapter. (Kleinfelder, Inc.)

شکل (پ-۲-۱): نمونه‌ای از گزارش نمونه‌برداری

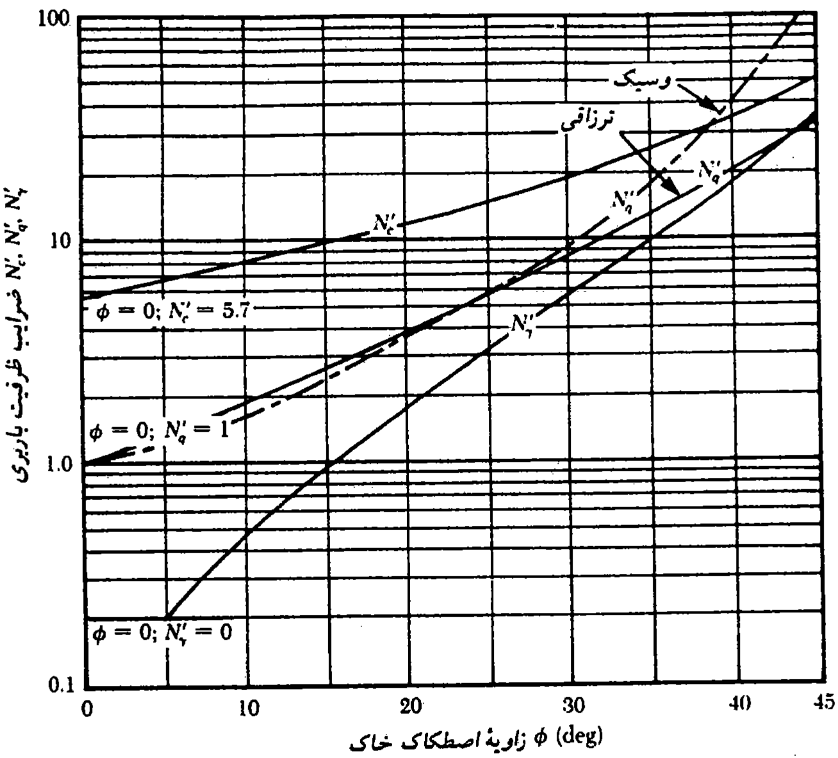


Penetrometers.

شکل (پ-۲-۲): آزمایش CPT دینامیکی



شکل (پ-۳-۱): ضرایب ظرفیت باربری ترزاقی برای گسیختگی برشی کلی



شکل (پ-۳-۲): ضرایب ظرفیت باربری اصلاح شده‌ی ترزاقی-وسیک برای گسیختگی برشی موضعی

جدول (پ-۳-۳): ضرایب ظرفیت باربری (وسیک ۱۹۷۳)

ϕ	N_c	N_q	N_γ	N_q/N_c	$\tan\phi$
0	5.14	1.00	0.00	0.20	0.00
1	5.38	1.09	0.07	0.20	0.02
2	5.63	1.20	0.15	0.21	0.03
3	5.90	1.31	0.24	0.22	0.05
4	6.19	1.43	0.34	0.23	0.07
5	6.49	1.57	0.45	0.24	0.09
6	6.81	1.72	0.57	0.25	0.11
7	7.16	1.88	0.71	0.26	0.12
8	7.53	2.06	0.86	0.27	0.14
9	7.92	2.25	1.03	0.28	0.16
10	8.35	2.47	1.22	0.30	0.18
11	8.80	2.71	1.44	0.31	0.19
12	9.28	2.97	1.69	0.32	0.21
13	9.81	3.26	1.97	0.33	0.23
14	10.37	3.59	2.29	0.35	0.25
15	10.98	3.94	2.65	0.36	0.27
16	11.63	4.34	3.06	0.37	0.29
17	12.34	4.77	3.53	0.39	0.31
18	13.10	5.26	4.07	0.40	0.32
19	13.93	5.80	4.68	0.42	0.34
20	14.83	6.40	5.39	0.43	0.36
21	15.82	7.07	6.20	0.45	0.38
22	16.88	7.82	7.13	0.46	0.40
23	18.05	8.66	8.20	0.48	0.42
24	19.32	9.60	9.44	0.50	0.45
25	20.72	10.66	10.88	0.51	0.47
26	22.25	11.85	12.54	0.53	0.49
27	23.94	13.20	14.47	0.55	0.51
28	25.80	14.72	16.72	0.57	0.53
29	27.86	16.44	19.34	0.59	0.55
30	30.14	18.40	22.40	0.61	0.58
31	32.67	20.63	25.99	0.63	0.60
32	35.49	23.18	30.22	0.65	0.62
33	38.64	26.09	35.19	0.68	0.65
34	42.16	29.44	41.06	0.70	0.67
35	46.12	33.30	48.03	0.72	0.70
36	50.59	37.75	56.31	0.75	0.73
37	55.63	42.92	66.19	0.77	0.75
38	61.35	48.93	78.03	0.80	0.78
39	67.87	55.96	92.25	0.82	0.81
40	75.31	64.20	109.41	0.85	0.84
41	83.86	73.90	130.22	0.88	0.87
42	93.71	85.38	155.55	0.91	0.90
43	105.11	99.02	186.54	0.94	0.93
44	118.37	115.31	224.64	0.97	0.97
45	133.88	134.88	271.76	1.01	1.00
46	152.10	158.51	330.35	1.04	1.04
47	173.64	187.21	403.67	1.08	1.07
48	199.26	222.31	496.01	1.12	1.11
49	229.93	265.51	613.16	1.15	1.15
50	266.89	319.07	762.89	1.20	1.19

جدول (پ-۳-۴): جدول ضرایب ظرفیت باربری ترزاقی

the Terzaghi equations

Values of N_γ for ϕ of 34 and 48° are original Terzaghi values and used to back-compute $K_{p\gamma}$ for forward computations of N_γ by author

ϕ, deg	N_c	N_q	N_γ	$K_{p\gamma}$
0	5.7	1.0	0.0	10.8
5	7.3	1.6	0.5	12.2
10	9.6	2.7	1.2	14.7
15	12.9	4.4	2.5	18.6
20	17.7	7.4	5.0	25.0
25	25.1	12.7	9.7	35.0
30	37.2	22.5	19.7	52.0
34	52.6	36.5	36.0	
35	57.8	41.4	42.4	82.0
40	95.7	81.3	100.4	141.0
45	172.3	173.3	297.5	298.0
48	258.3	287.9	780.1	
50	347.5	415.1	1153.2	800.0

جدول (پ-۳-۵): ضرایب ظرفیت باربری میرهوف، هانسن و وسیک

Bearing-capacity factors for the Meyerhof, Hansen, and Vesić bearing-capacity equations

Note that N_c and N_q are the same for all three methods; subscripts identify author for N_γ

ϕ	N_c	N_q	$N_{\gamma(H)}$	$N_{\gamma(M)}$	$N_{\gamma(V)}$	N_q/N_c	$2\tan\phi(1-\sin\phi)^2$
0	5.14*	1.0	0.0	0.0	0.0	0.195	0.000
5	6.49	1.6	0.1	0.1	0.4	0.242	0.146
10	8.34	2.5	0.4	0.4	1.2	0.296	0.241
15	10.97	3.9	1.2	1.1	2.6	0.359	0.294
20	14.83	6.4	2.9	2.9	5.4	0.431	0.315
25	20.71	10.7	6.8	6.8	10.9	0.514	0.311
26	22.25	11.8	7.9	8.0	12.5	0.533	0.308
28	25.79	14.7	10.9	11.2	16.7	0.570	0.299
30	30.13	18.4	15.1	15.7	22.4	0.610	0.289
32	35.47	23.2	20.8	22.0	30.2	0.653	0.276
34	42.14	29.4	28.7	31.1	41.0	0.698	0.262
36	50.55	37.7	40.0	44.4	56.2	0.746	0.247
38	61.31	48.9	56.1	64.0	77.9	0.797	0.231
40	75.25	64.1	79.4	93.6	109.3	0.852	0.214
45	133.73	134.7	200.5	262.3	271.3	1.007	0.172
50	266.50	318.5	567.4	871.7	761.3	1.195	0.131

* $= \pi + 2$ as limit when $\phi \to 0°$.

Slight differences in above table can be obtained using program BEARING.EXE on diskette depending on computer used and whether or not it has floating point.

شکل (پ-۳-۶): فرمول ضرایب باربری به روش هانسن

Shape factors	Depth factors
$s'_{c(H)} = 0.2\frac{B'}{L'} \quad (\phi = 0°)$ $s_{c(H)} = 1.0 + \frac{N_q}{N_c} \cdot \frac{B'}{L'}$ $s_{c(V)} = 1.0 + \frac{N_q}{N_c} \cdot \frac{B}{L}$ $s_c = 1.0$ for strip	$d'_c = 0.4k \quad (\phi = 0°)$ $d_c = 1.0 + 0.4k$ $k = D/B$ for $D/B \leq 1$ $k = \tan^{-1}(D/B)$ for $D/B > 1$ k in radians
$s_{q(H)} = 1.0 + \frac{B'}{L'}\sin\phi$ $s_{q(V)} = 1.0 + \frac{B}{L}\tan\phi$ for all ϕ	$d_q = 1 + 2\tan\phi(1 - \sin\phi)^2 k$ k defined above
$s_{\gamma(H)} = 1.0 - 0.4\frac{B'}{L'} \quad \geq 0.6$ $s_{\gamma(V)} = 1.0 - 0.4\frac{B}{L} \quad \geq 0.6$	$d_\gamma = 1.00 \quad$ for all ϕ

Notes:

1. Note use of "effective" base dimensions B', L' by Hansen but not by Vesić.
2. The values above are consistent with either a vertical load or a vertical load accompanied by a horizontal load H_B.
3. With a vertical load and a load H_L (and either $H_B = 0$ or $H_B > 0$) you may have to compute two sets of shape s_i and d_i as $s_{i,B}$, $s_{i,L}$ and $d_{i,B}$, $d_{i,L}$. For i, L subscripts of Eq. (4-2), presented in Sec. 4-6, use ratio L'/B' or D/L'.

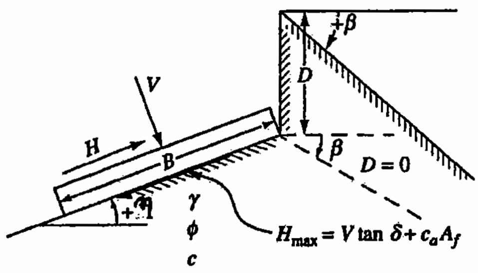
Inclination factors	Ground factors (base on slope)
$i'_c = 0.5 - \sqrt{1 - \frac{H_i}{A_f c_a}}$	$g'_c = \frac{\beta°}{147°}$
$i_c = i_q - \frac{1 - i_q}{N_q - 1}$	$g_c = 1.0 - \frac{\beta°}{147°}$
$i_q = \left[1 - \frac{0.5H_i}{V + A_f c_a \cot\phi}\right]^{\alpha_1}$ $2 \leq \alpha_1 \leq 5$	$g_q = g_\gamma = (1 - 0.5\tan\beta)^5$
	Base factors (tilted base)
$i_\gamma = \left[1 - \frac{0.7H_i}{V + A_f c_a \cot\phi}\right]^{\alpha_2}$	$b'_c = \frac{\eta°}{147°} \quad (\phi = 0)$
$i_\gamma = \left[1 - \frac{(0.7 - \eta°/450°)H_i}{V + A_f c_a \cot\phi}\right]^{\alpha_2}$ $2 \leq \alpha_2 \leq 5$	$b_c = 1 - \frac{\eta°}{147°} \quad (\phi > 0)$ $b_q = \exp(-2\eta\tan\phi)$ $b_\gamma = \exp(-2.7\eta\tan\phi)$ η in radians

Notes:

1. Use H_i as either H_B or H_L, or both if $H_L > 0$.
2. Hansen (1970) did not give an i_c for $\phi > 0$. The value above is from Hansen (1961) and also used by Vesić.
3. Variable c_a = base adhesion, on the order of 0.6 to 1.0 × base cohesion.
4. Refer to sketch for identification of angles η and β, footing depth D, location of H_i (parallel and at top of base slab; usually also produces eccentricity). Especially note V = force *normal* to base and is not the resultant R from combining V and H_i.

Notes: $\beta + \eta$ 90° (Both β and η have signs (+) shown.)

β ϕ



δ = friction angle between base and soil ($.5\phi \leq \delta \leq \phi$)

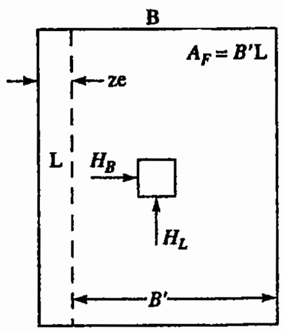
For: $L/B \leq 2$ use ϕ_{tr}

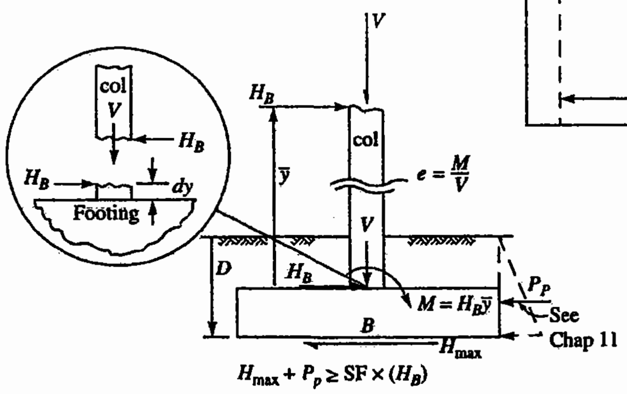
$L/B > 2$ use $\phi_{ps} = 1.5\phi_{tr} - 17°$

$\phi_{tr} \leq 34°$ use $\phi_{tr} = \phi_{ps}$

$A_f = B'L'$ (effective area)

c_a = base adhesion (0.6 to 1.0c)





جدول (پ-۳-۷): ضرایب ظرفیت باربری برای شالوده‌هایی که بر روی شیب قرار دارند

Bearing capacity N'_c, N'_q for footings on or adjacent to a slope

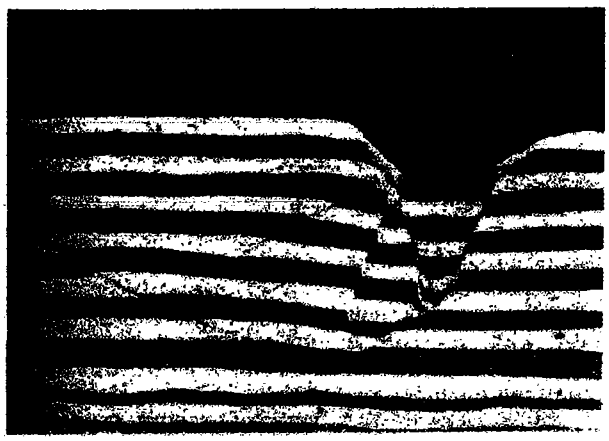
Refer to Fig. 4-4 for variable identification. Base values ($\beta = 0$) may be used when length or area ratios > 1 or when $b/B > 1.5$ to 2.0 (approximate). Values given should cover usual range of footing locations and depths of embedment.

		D/B = 0 b/B = 0					D/B = 0.75 b/B = 0					D/B = 1.50 b/B = 0				
β↓		φ = 0	10	20	30	40	0	10	20	30	40	0	10	20	30	40
0°	N'_c =	5.14	8.35	14.83	30.14	75.31	5.14	8.35	14.83	30.14	75.31	5.14	8.25	14.83	30.14	75.31
	N'_q =	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	64.20
10°		4.89	7.80	13.37	26.80	64.42	5.14	8.35	14.83	30.14	75.31	5.14	8.35	14.83	30.14	75.31
		1.03	2.47	6.40	18.40	64.20	0.92	1.95	4.43	11.16	33.94	1.03	2.47	5.85	14.13	40.81
20°		4.63	7.28	12.39	23.78	55.01	5.14	8.35	14.83	30.14	66.81	5.14	8.35	14.83	30.14	75.31
		1.03	2.47	6.40	18.40	64.20	0.94	1.90	4.11	9.84	28.21	1.03	2.47	5.65	12.93	35.14
25°		4.51	7.02	11.82	22.38	50.80	5.14	8.35	14.83	28.76	62.18	5.14	8.35	14.83	30.14	73.57
		1.03	2.47	6.40	18.40	64.20	0.92	1.82	3.85	9.00	25.09	1.03	2.47	5.39	12.04	31.80
30°		4.38	6.77	11.28	21.05	46.88	5.14	8.35	14.83	27.14	57.76	5.14	8.35	14.83	30.14	68.64
		1.03	2.47	6.40	18.40	64.20	0.88	1.71	3.54	8.08	21.91	1.03	2.47	5.04	10.99	28.33
60°		3.62	5.33	8.33	14.34	28.56	4.70	6.83	10.55	17.85	34.84	5.14	8.34	12.76	21.37	41.12
		1.03	2.47	6.40	18.40	64.20	0.37	0.63	1.17	2.36	5.52	0.62	1.04	1.83	3.52	7.80

	D/B = 0 b/B = 0.75					D/B = 0.75 b/B = 0.75					D/B = 1.50 b/B = 0.75				
β↓	0	10	20	30	40	0	10	20	30	40	0	10	20	30	40
10°	5.14	8.33	14.34	28.02	66.60	5.14	8.35	14.83	30.14	75.31	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.34	5.34	13.47	40.83	1.03	2.47	6.40	15.79	45.45
20°	5.14	8.31	13.90	26.19	59.31	5.14	8.35	14.83	30.14	71.11	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.04	14.39	40.88	1.03	2.47	6.40	16.31	43.96
25°	5.14	8.29	13.69	25.36	56.11	5.14	8.35	14.83	30.14	67.49	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.27	14.56	40.06	1.03	2.47	6.40	16.20	42.35
30°	5.14	8.27	13.49	24.57	53.16	5.14	8.35	14.83	30.14	64.04	5.14	8.35	14.83	30.14	74.92
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	14.52	38.72	1.03	2.47	6.40	15.85	40.23
60°	5.14	7.94	12.17	20.43	39.44	5.14	8.35	14.38	23.94	45.72	5.14	8.35	14.83	27.46	52.00
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	5.14	10.05	22.56	1.03	2.47	4.97	9.41	20.33
	D/B = 0 b/B = 1.50					D/B = 0.75 b/B = 1.50					D/B = 1.50 b/B = 1.50				
10°	5.14	8.35	14.83	29.24	68.78	5.14	8.35	14.83	30.14	75.31	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.01	15.39	47.09	1.03	2.47	6.40	17.26	49.77
20°	5.14	8.35	14.83	28.59	63.60	5.14	8.35	14.83	30.14	75.31	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	53.21	1.03	2.47	6.40	18.40	52.58
25°	5.14	8.35	14.83	28.33	61.41	5.14	8.35	14.83	30.14	72.80	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	55.20	1.03	2.47	6.40	18.40	52.97
30°	5.14	8.35	14.83	28.09	59.44	5.14	8.35	14.83	30.14	70.32	5.14	8.35	14.83	30.14	75.31
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	56.41	1.03	2.47	6.40	18.40	52.63
60°	5.14	8.35	14.83	26.52	50.32	5.14	8.35	14.83	30.03	56.60	5.14	8.35	14.83	30.14	62.88
	1.03	2.47	6.40	18.40	64.20	1.03	2.47	6.40	18.40	46.18	1.03	2.47	6.40	16.72	36.17

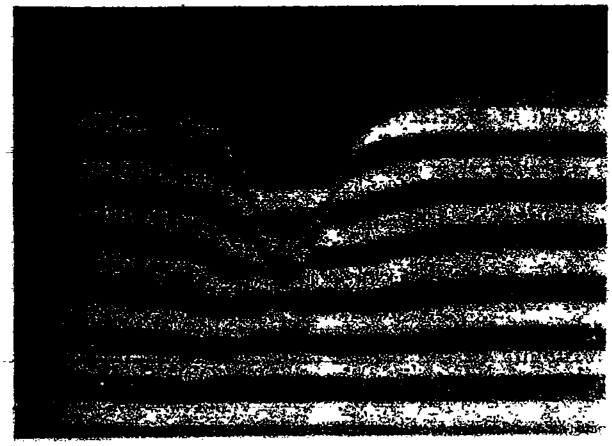
Bearing capacity failure of a silo foundation. (From Tschebotarioff, 1951.)

شکل (پ-۳-۸): خرابی فونداسیون یک سیلو بر اثر شکست ظرفیت باربری



General shear failure pattern under a rectangular footing on dense sand (D_r = 100%). (From De Beer and Vesić, 1958.)

شکل (پ-۳-۹): الگوی شکست برشی کلی در زیر یک پی مستطیلی

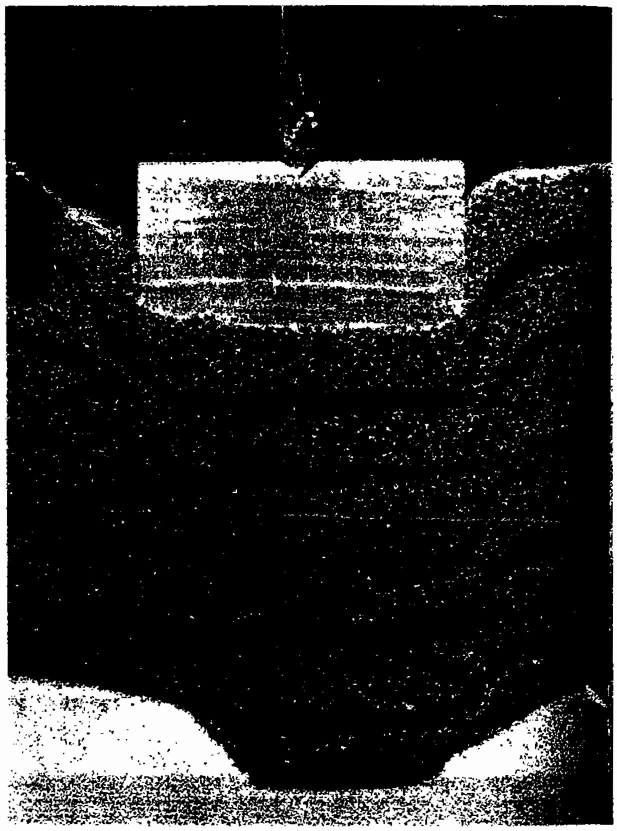


Local shear failure pattern under a rectangular footing on medium dense sand (D_r = 47%). (From De Beer and Vesić, 1958.)

شکل (پ-۳-۱۰): الگوی شکست برشی محلی در زیر یک پی مستطیلی

Punching shear failure pattern under a rectangular foundation on the surface of loose sand (D_r = 15%). (From De Beer and Vesić, 1958.)

شکل (پ-۳-۱۱): الگوی شکست برش پانچ در زیر یک پی مستطیلی و بر روی سطح ماسه‌ای شل



Punching shear failure of a rectangular footing on dense sand underlain by soft clay. (From Vesić, 1970.)

شکل (پ-۳-۱۲): الگوی شکست برش پانچ در زیر یک پی مستطیلی و بر روی سطح ماسه‌ای متراکم

Punching shear failure under a deep rectangular foundation in dense sand (D_r = 90%, B = 1.5 in, D = 15 in). (From Vesić, 1963a.)

شکل (پ-۳-۱۳): شکست برش پانچ در زیر یک پی مستطیلی عمیق

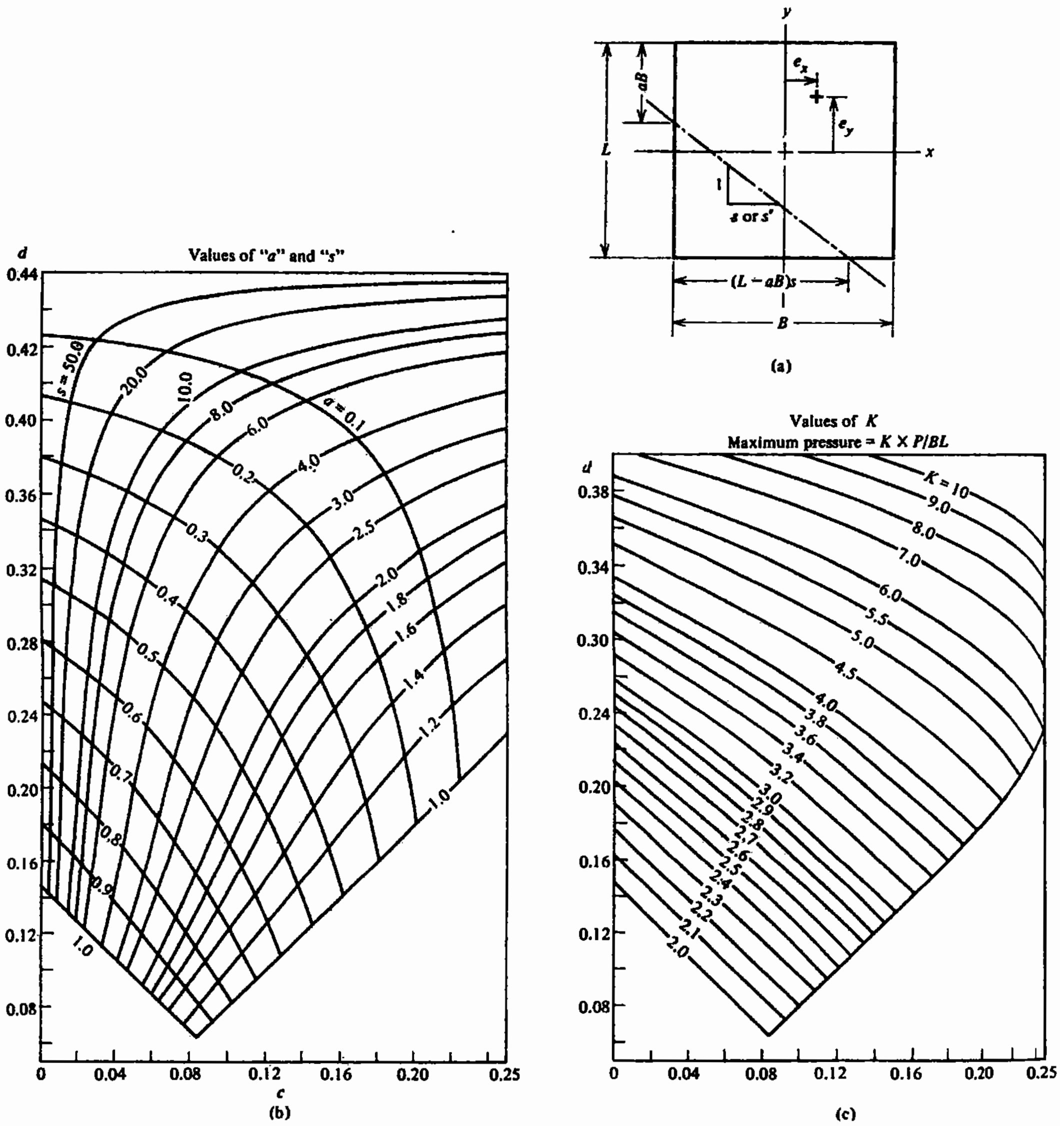
جدول (پ-۴-۱): پارامترهای الاستیک خاک‌های مختلف

نوع خاک		ضریب الاستیسیته E_s		نسبت پواسون μ_s
		MN/m^2	$lb/in.^2$	
ماسهٔ شل	Loose sand	10.35– 24.15	1,500– 3,500	0.20–0.40
ماسه با تراکم متوسط	Medium dense sand	17.25– 27.60	2,500– 4,000	0.25–0.40
ماسهٔ متراکم	Dense sand	34.50– 55.20	5,000– 8,000	0.30–0.45
ماسهٔ لای‌دار	Silty sand	10.35– 17.25	1,500– 2,500	0.20–0.40
ماسه و شن	Sand and gravel	69.00–172.50	10,000–25,000	0.15–0.35
رس نرم	Soft clay	2.07– 5.18	300– 750	
رس متوسط	Medium clay	5.18– 10.35	750– 1,500	0.20–0.50
رس سفت	Stiff clay	10.35– 24.15	1,500– 3,500	

جدول (پ-۴-۲): مقادیر ضریب پواسون برای انواع مختلف خاک

Values or value ranges for Poisson's ratio μ

Type of soil	μ
Clay, saturated	0.4–0.5
Clay, unsaturated	0.1–0.3
Sandy clay	0.2–0.3
Silt	0.3–0.35
Sand, gravelly sand	−0.1–1.00
commonly used	0.3–0.4
Rock	0.1–0.4 (depends somewhat on type of rock)
Loess	0.1–0.3
Ice	0.36
Concrete	0.15
Steel	0.33



Method of finding line of zero pressure beneath eccentrically loaded rigid footings. (a) Identification of terms; (b) curves to find line of zero pressure; (c) curves to find maximum soil pressure. (Courtesy Prof. H. J. Plock.)

Notes:

$$c = \frac{e_x}{B} \quad d = \frac{e_y}{L}$$

To use charts interchange c and d if $c > d$ for rectangle $s' = (B/L)$

If not certain of location of a B compute approximate line of zero pressure using Eq. 16.7—actual line is somewhat closer to resultant loads.

Maximum soil pressure = Kq_{av}; $q_{av} = P/A_{total}$

شکل (پ-۶-۱): نمودار تعیین خط تنش صفر در پی‌های تحت لنگر دوجانبه

جدول (پ-۹-۱): مقادیر ضریب فشار محرک کولمب

Coulomb active earth pressure coefficients K_a

ALPHA = 90 BETA = −10

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.354	0.328	0.304	0.281	0.259	0.239	0.220	0.201	0.184
16	0.311	0.290	0.270	0.252	0.234	0.216	0.200	0.184	0.170
17	0.309	0.289	0.269	0.251	0.233	0.216	0.200	0.184	0.169
20	0.306	0.286	0.267	0.249	0.231	0.214	0.198	0.183	0.169
22	0.304	0.285	0.266	0.248	0.230	0.214	0.198	0.183	0.168

ALPHA = 90 BETA = −5

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.371	0.343	0.318	0.293	0.270	0.249	0.228	0.209	0.191
16	0.328	0.306	0.284	0.264	0.245	0.226	0.209	0.192	0.176
17	0.327	0.305	0.283	0.263	0.244	0.226	0.208	0.192	0.176
20	0.324	0.302	0.281	0.261	0.242	0.224	0.207	0.191	0.175
22	0.322	0.301	0.280	0.260	0.242	0.224	0.207	0.191	0.175

ALPHA = 90 BETA = 0

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.390	0.361	0.333	0.307	0.283	0.260	0.238	0.217	0.198
16	0.349	0.324	0.300	0.278	0.257	0.237	0.218	0.201	0.184
17	0.348	0.323	0.299	0.277	0.256	0.237	0.218	0.200	0.183
20	0.345	0.320	0.297	0.276	0.255	0.235	0.217	0.199	0.183
22	0.343	0.319	0.296	0.275	0.254	0.235	0.217	0.199	0.183

ALPHA = 90 BETA = 5

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.414	0.382	0.352	0.323	0.297	0.272	0.249	0.227	0.206
16	0.373	0.345	0.319	0.295	0.272	0.250	0.229	0.210	0.192
17	0.372	0.344	0.318	0.294	0.271	0.249	0.229	0.210	0.192
20	0.370	0.342	0.316	0.292	0.270	0.248	0.228	0.209	0.191
22	0.369	0.341	0.316	0.292	0.269	0.248	0.228	0.209	0.191

ALPHA = 90 BETA = 10

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.443	0.407	0.374	0.343	0.314	0.286	0.261	0.238	0.216
16	0.404	0.372	0.342	0.315	0.289	0.265	0.242	0.221	0.201
17	0.404	0.371	0.342	0.314	0.288	0.264	0.242	0.221	0.201
20	0.402	0.370	0.340	0.313	0.287	0.263	0.241	0.220	0.201
22	0.401	0.369	0.340	0.312	0.287	0.263	0.241	0.220	0.201

ALPHA = 90 BETA = 15

δ	ϕ = 26	28	30	32	34	36	38	40	42
0	0.482	0.440	0.402	0.367	0.334	0.304	0.276	0.251	0.227
16	0.447	0.408	0.372	0.340	0.310	0.283	0.258	0.234	0.213
17	0.447	0.407	0.372	0.339	0.310	0.282	0.257	0.234	0.212
20	0.446	0.406	0.371	0.338	0.309	0.282	0.257	0.234	0.212
22	0.446	0.406	0.371	0.338	0.309	0.282	0.257	0.234	0.212

جدول (پ-۹-۲): مقادیر ضرایب فشار مقاوم کولمب

Coulomb passive earth pressure coefficients K_p

ALPHA = 90 BETA = −10

δ	φ = 26	28	30	32	34	36	38	40	42
0	1.914	2.053	2.204	2.369	2.547	2.743	2.957	3.193	3.452
16	2.693	2.956	3.247	3.571	3.934	4.344	4.807	5.335	5.940
17	2.760	3.034	3.339	3.679	4.062	4.493	4.983	5.543	6.187
20	2.980	3.294	3.645	4.041	4.488	4.997	5.581	6.255	7.039
22	3.145	3.490	3.878	4.317	4.816	5.389	6.050	6.819	7.720

ALPHA = 90 BETA = −5

δ	φ = 26	28	30	32	34	36	38	40	42
0	2.223	2.392	2.577	2.781	3.004	3.250	3.523	3.826	4.163
16	3.367	3.709	4.094	4.529	5.024	5.591	6.243	7.000	7.883
17	3.469	3.828	4.234	4.694	5.218	5.820	6.516	7.326	8.277
20	3.806	4.226	4.704	5.250	5.879	6.609	7.462	8.468	9.665
22	4.064	4.532	5.067	5.684	6.399	7.236	8.222	9.397	10.809

ALPHA = 90 BETA = 0

δ	φ = 26	28	30	32	34	36	38	40	42
0	2.561	2.770	3.000	3.255	3.537	3.852	4.204	4.599	5.045
16	4.195	4.652	5.174	5.775	6.469	7.279	8.229	9.356	10.704
17	4.346	4.830	5.385	6.025	6.767	7.636	8.661	9.882	11.351
20	4.857	5.436	6.105	6.886	7.804	8.892	10.194	11.771	13.705
22	5.253	5.910	6.675	7.574	8.641	9.919	11.466	13.364	15.726

ALPHA = 90 BETA = 5

δ	φ = 26	28	30	32	34	36	38	40	42
0	2.943	3.203	3.492	3.815	4.177	4.585	5.046	5.572	6.173
16	5.250	5.878	6.609	7.464	8.474	9.678	11.128	12.894	15.076
17	5.475	6.146	6.929	7.850	8.942	10.251	11.836	13.781	16.201
20	6.249	7.074	8.049	9.212	10.613	12.321	14.433	17.083	20.468
22	6.864	7.820	8.960	10.334	12.011	14.083	16.685	20.011	24.352

ALPHA = 90 BETA = 10

δ	φ = 26	28	30	32	34	36	38	40	42
0	3.385	3.712	4.080	4.496	4.968	5.507	6.125	6.840	7.673
16	6.652	7.545	8.605	9.876	11.417	13.309	15.665	18.647	22.497
17	6.992	7.956	9.105	10.492	12.183	14.274	16.899	20.254	24.633
20	8.186	9.414	10.903	12.733	15.014	17.903	21.636	26.569	33.270
22	9.164	10.625	12.421	14.659	17.497	21.164	26.012	32.601	41.863

ALPHA = 90 BETA = 15

δ	φ = 26	28	30	32	34	36	38	40	42
0	3.913	4.331	4.807	5.352	5.980	6.710	7.563	8.570	9.768
16	8.611	9.936	11.555	13.557	16.073	19.291	23.494	29.123	36.894
17	9.139	10.590	12.373	14.595	17.413	21.054	25.867	32.409	41.603
20	11.049	12.986	15.422	18.541	22.617	28.080	35.629	46.458	62.759
22	12.676	15.067	18.130	22.136	27.506	34.930	45.584	61.626	87.354

جدول (پ-۹-۳): ضرایب فشار محرک زمین در روش رانکین

Rankine active earth pressure coefficients K_a

β	ϕ = 26	28	30	32	34	36	38	40	42
0	0.3905	0.3610	0.3333	0.3073	0.2827	0.2596	0.2379	0.2174	0.1982
5	0.3959	0.3656	0.3372	0.3105	0.2855	0.2620	0.2399	0.2192	0.1997
10	0.4134	0.3802	0.3495	0.3210	0.2944	0.2696	0.2464	0.2247	0.2044
15	0.4480	0.4086	0.3729	0.3405	0.3108	0.2834	0.2581	0.2346	0.2129
20	0.5152	0.4605	0.4142	0.3739	0.3381	0.3060	0.2769	0.2504	0.2262
25	0.6999	0.5727	0.4936	0.4336	0.3847	0.3431	0.3070	0.2750	0.2465
30	—	—	0.8660	0.5741	0.4776	0.4105	0.3582	0.3151	0.2784
35	—	—	—	—	—	0.5971	0.4677	0.3906	0.3340
40	—	—	—	—	—	—	—	0.7660	0.4668

جدول (پ-۹-۴): ضرایب فشار مقاوم زمین در روش رانکین

Rankine passive earth pressure coefficients K_p

β	ϕ = 26	28	30	32	34	36	38	40	42
0	2.5611	2.7698	3.0000	3.2546	3.5371	3.8518	4.2037	4.5989	5.0447
5	2.5070	2.7145	2.9431	3.1957	3.4757	3.7875	4.1360	4.5272	4.9684
10	2.3463	2.5507	2.7748	3.0216	3.2946	3.5980	3.9365	4.3161	4.7437
15	2.0826	2.2836	2.5017	2.7401	3.0024	3.2926	3.6154	3.9766	4.3827
20	1.7141	1.9176	2.1318	2.3618	2.6116	2.8857	3.1888	3.5262	3.9044
25	1.1736	1.4343	1.6641	1.8942	2.1352	2.3938	2.6758	2.9867	3.3328
30	—	—	0.8660	1.3064	1.5705	1.8269	2.0937	2.3802	2.6940
35	—	—	—	—	—	1.1239	1.4347	1.7177	2.0088
40	—	—	—	—	—	—	—	0.7660	1.2570

جدول (پ-۹-۵): مقادیر زاویه‌ی اصطکاک بین مواد تشکیل دهنده‌ی پی و خاک یا سنگ

Friction angles δ between various foundation materials and soil or rock*

Interface materials	Friction angle, δ, degrees†
Mass concrete or masonry on the following:	
Clean sound rock	35°
Clean gravel, gravel-sand mixtures, coarse sand	ϕ
Clean fine to medium sand, silty medium to coarse sand, silty or clayey gravel	ϕ
Clean fine sand, silty or clayey fine to medium sand	ϕ
Fine sandy silt, nonplastic silt	ϕ
Very stiff and hard residual or preconsolidated clay	ϕ
Medium stiff and stiff clay and silty clay	ϕ
Steel sheet piles against the following:	
Clean gravel, gravel-sand mixture, well-graded rock fill with spalls	22°
Clean sand, silty sand-gravel mixture, single-size hard rock fill	17
Silty sand, gravel, or sand mixed with silt or clay	14
Fine sandy silt, nonplastic silt	11
Formed concrete or concrete sheetpiling against the following:	
Clean gravel, gravel-sand mixtures, well-graded rock fill with spalls	22–26
Clean sand, silty sand-gravel mixture, single-size hard rock fill	17–22
Silty sand, gravel, or sand mixed with silt or clay	17
Fine sandy silt, nonplastic silt	14
Various structural materials	
Masonry on masonry, igneous and metamorphic rocks:	
Dressed soft rock on dressed soft rock	35°
Dressed hard rock on dressed soft rock	33
Dressed hard rock on dressed hard rock	29
Masonry on wood (cross grain)	26
Steel on steel at sheet-pile interlocks	17
Wood on soil	14–16‡

*May be stress-dependent (see text) for sand.

†Single values ±2°. Alternate for concrete poured on soil is $\delta = \phi$.

‡May be higher in dense sand or if sand penetrates wood.

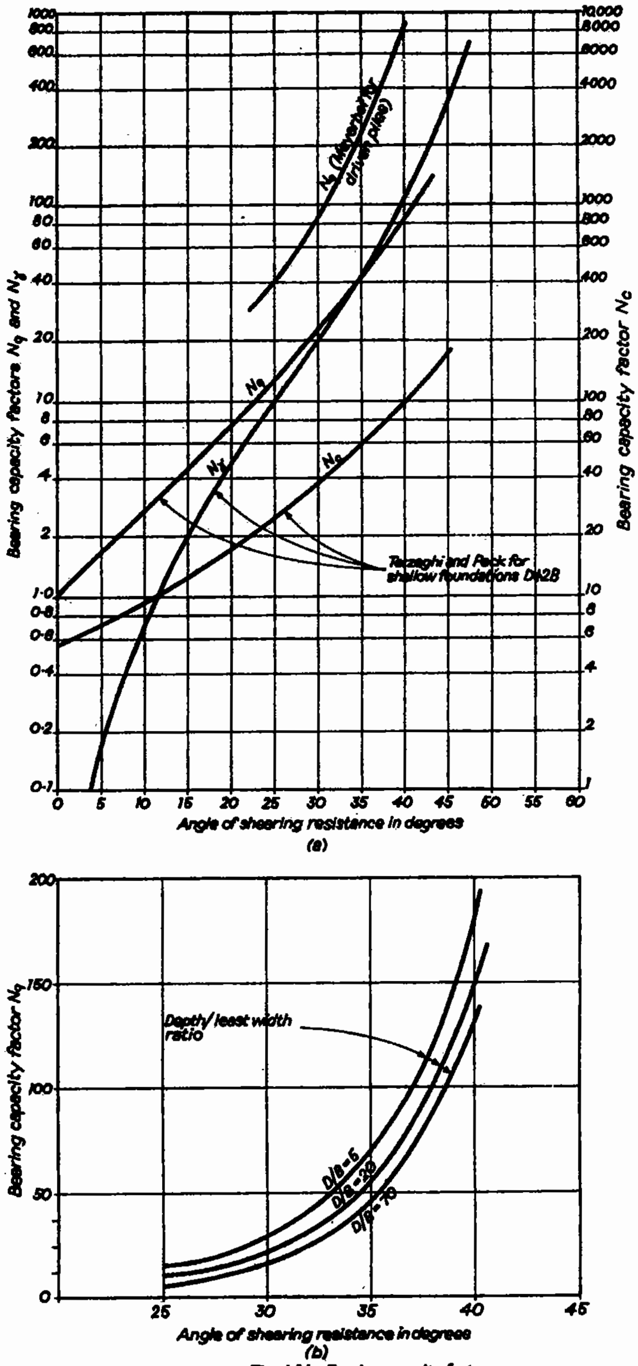


Fig. 4.14 Bearing capacity factors

(a) Values of N_c, N_q and N_γ (after Meyerhof[4.1] and Terzaghi and Peck[4.17]) *(b) Berezantsev's values of N_q[4.18]*

نمودار (پ-۱۰-۱): مقادیر ضریب ظرفیت باربری در شمع‌ها