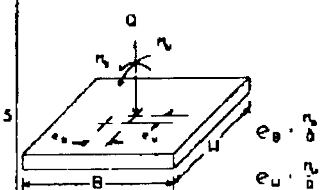
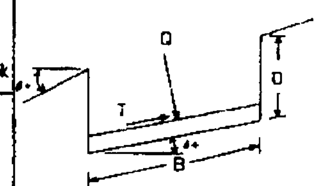
TABLE 4-5

Hansen Dimensionless Bearing Capacity and Correction Factors (Data from Hansen 1970)

FACTOR			COHESION (c)	WEDGE (γ)	SURCHARGE (q)	DIAGRAM
BEARING CAPACITY N			N_c	N_γ	N_q	
		$\phi = 0$	5.14	0.00	1.00	
		$\phi > 0$	$(N_q - 1)\cot\phi$	$1.5(N_q - 1)\tan\phi$	$N_\phi e^{\pi \tan\phi}$	
CORRECTION ζ	FOUNDATION SHAPE WITH ECCENTRICITY s		ζ_{cs}	$\zeta_{\gamma s}$	ζ_{qs}	
			Strip: 1.0			
		$\phi = 0$	$0.2 \cdot \frac{B'}{W'}$	1.0	1.0	
		$\phi > 0$	$1 + \frac{N_q B'}{N_c W'}$	$1 - 0.4 \cdot \frac{B'}{W'}$	$1 + \frac{B'}{W'} \tan\phi$	
	INCLINED LOADING i		ζ_{ci}	$\zeta_{\gamma i}$	ζ_{qi}	
		$\phi = 0$	$\frac{1 - \left[1 - \frac{T}{A_e c_a}\right]^{\frac{1}{2}}}{2}$	$\delta=0$ $\left[1 - \frac{0.7T}{Q + A_e c_a \cot\phi}\right]^5$	$\left[1 - \frac{0.5T}{Q + A_e c_a \cot\phi}\right]^5$	
		$\phi > 0$	$\zeta_{qi} - \frac{1 - \zeta_{qi}}{N_q - 1}$	$\delta>0$ $\left[1 - \frac{(0.7 - \delta/450)T}{Q + A_e c_a \cot\phi}\right]^5$		
	FOUNDATION DEPTH d		ζ_{cd}	$\zeta_{\gamma d}$	ζ_{qd}	
		$\phi = 0$	0.4k	1.0	1.0	
		$\phi > 0$	1 + 0.4k	1.0	$1 + 2\tan\phi(1 - \sin\phi)^2 k$	
	BASE ON SLOPE β		$\zeta_{c\beta}$	$\zeta_{\gamma\beta}$	$\zeta_{q\beta}$	
		$\phi = 0$	$1 - \frac{\beta}{147.3}$	$(1 - 0.5\tan\beta)^5$	$(1 - 0.5\tan\beta)^5$	$\beta + \delta \le 90°$ $\beta < \phi$
		$\phi > 0$	$\zeta_{q\beta} - \frac{1 - \zeta_{q\beta}}{147.3}$			
	TILTED BASE δ		$\zeta_{c\delta}$	$\zeta_{\gamma\delta}$	$\zeta_{q\delta}$	
		$\phi = 0$	$1 - \frac{\delta}{147}$	$e^{-0.047\delta\tan\phi}$	$e^{-0.035\delta\tan\phi}$	
		$\phi > 0$	$\zeta_{q\delta} - \frac{1 - \zeta_{q\delta}}{147.3}$			

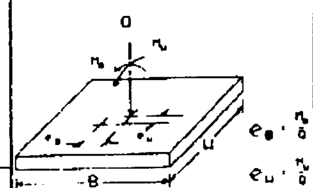
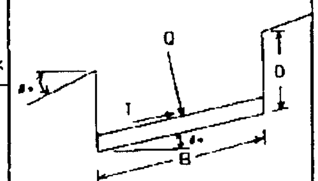
Note: Eccentricity and inclined loading correction factors may not be used simultaneously; factors not used are unity

Nomenclature:

- ϕ = angle of internal friction, degrees
- N_ϕ = $\tan^2(45 + \phi/2)$
- B' = effective width of foundation, $B - 2e_B$, ft
- W' = effective length of foundation, $W - 2e_W$, ft
- B = foundation width, ft
- W = foundation length, ft
- e_B = eccentricity parallel with B, M_B/Q
- e_W = eccentricity parallel with W, M_W/Q
- M_B = bending moment parallel with B, kips-ft
- M_W = bending moment parallel with W, kips-ft
- ϕ_a = friction angle between base and soil ≈ ϕ, degrees
- c_a = adhesion of soil to base ≤ c, ksf
- c = soil cohesion or undrained shear strength C_u, ksf
- δ = base tilt from horizontal, upward +, degrees
- β = slope of ground from base, downward +, degrees
- k = D/B if D/B ≤ 1 OR $\tan^{-1}(D/B)$ if D/B > 1 (in radians)
- D = foundation depth, ft
- Q = vertical load on foundation, kips
- T = horizontal load ≤ $Q\tan\phi + A_e c_a$, right +, kips
- A_e = effective area of foundation $B'W'$, ft^2

TABLE 4-6

Vesic Dimensionless Bearing Capacity and Correction Factors (Data from Vesic 1973; Vesic 1975)

FACTOR			COHESION (c)	WEDGE (γ)	SURCHARGE (q)	DIAGRAM
BEARING CAPACITY N			N_c	N_γ	N_q	
		$\phi = 0$	5.14	0.00 OR $-2\sin\beta$ if $\beta>0$	1.00	
		$\phi > 0$	$(N_q-1)\cot\phi$	$2(N_q+1)\tan\phi$	$N_\phi e^{\pi\tan\phi}$	
CORRECTION ζ	FOUNDATION SHAPE WITH ECCENTRICITY s		ζ_{cs}	$\zeta_{\gamma s}$	ζ_{qs}	
			Strip: 1.0			
		$\phi = 0$	$0.2 \cdot \frac{B'}{W'}$	1.0	1.0	
		$\phi > 0$	$1 + \frac{N_q B'}{N_c W'}$	$1 - 0.4 \cdot \frac{B'}{W'}$ (1.0 if strip)	$1 + \frac{B'}{W'}\tan\phi$ (1.0 if strip)	
	INCLINED LOADING i		ζ_{ci}	$\zeta_{\gamma i}$	ζ_{qi}	
		$\phi = 0$	$\frac{1 - \frac{mT}{A_e c_a N_c}}{2}$	$\left[1 - \frac{T}{Q + A_e c_a \cot\phi}\right]^{m+1} > 0$	$\left[1 - \frac{T}{Q + A_e c_a \cot\phi}\right]^{m}$	
		$\phi > 0$	$\zeta_{qi} - \frac{1 - \zeta_{qi}}{N_q - 1}$			
	FOUNDATION DEPTH d		ζ_{cd}	$\zeta_{\gamma d}$	ζ_{qd}	
		$\phi = 0$	$1 + 0.4K$	1.0	1.0	
		$\phi > 0$	$1 + 0.4k$	1.0	$1 + 2\tan\phi(1-\sin\phi)^2 k$	
	BASE ON SLOPE β		$\zeta_{c\beta}$	$\zeta_{\gamma\beta}$	$\zeta_{q\beta}$	
		$\phi = 0$	$1 - \frac{\beta}{147.3}$	$(1 - \tan\beta)^2$	$(1 - \tan\beta)^2$	$\beta + \delta \le 90°$ $\beta < \phi$
		$\phi > 0$	$\zeta_{q\beta} - \frac{1 - \zeta_{q\beta}}{147.3}$			
	TILTED BASE δ		$\zeta_{c\delta}$	$\zeta_{\gamma\delta}$	$\zeta_{q\delta}$	
		$\phi = 0$	$1 - \frac{\delta}{147}$	$(1 - 0.017\delta\tan\phi)^2$	$(1 - 0.017\delta\tan\phi)^2$	
		$\phi > 0$	$\zeta_{q\delta} - \frac{1 - \zeta_{q\delta}}{147.3}$			

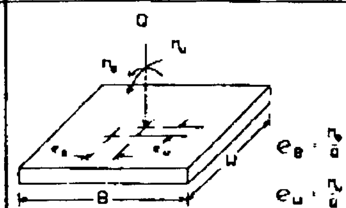
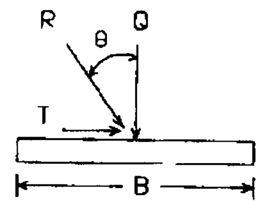
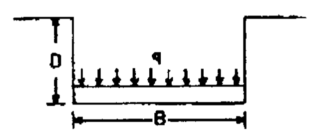
Note: Eccentricity and inclined loading correction factors may not be used simultaneously; factors not used are unity

Nomenclature:

- ϕ = angle of internal friction, degrees
- N_ϕ = $\tan^2(45 + \phi/2)$
- B' = effective width of foundation, $B - 2e_B$, ft
- W' = effective length of foundation, $W - 2e_W$, ft
- B = foundation width, ft
- W = foundation length, ft
- e_B = eccentricity parallel with B, M_B/Q
- e_W = eccentricity parallel with W, M_W/Q
- M_B = bending moment parallel with B, kips-ft
- M_W = bending moment parallel with W, kips-ft
- ϕ_a = friction angle between base and soil ≈ ϕ, degrees
- c_a = adhesion of soil to base ≤ c, ksf
- c = soil cohesion or undrained shear strength C_U, ksf
- δ = base tilt from horizontal, upward +, degrees
- β = slope of ground from base, downward +, degrees
- k = D/B if $D/B \le 1$ OR $\tan^{-1}(D/B)$ if $D/B > 1$ (in radians)
- D = foundation depth, ft
- Q = vertical load on foundation, kips
- T = horizontal load ≤ $Q\tan\phi + A_e c_a$, right +, kips
- A_e = effective area of foundation $B'W'$, ft^2
- m = $\frac{2 + R_{BW}}{1 + R_{BW}}$, $R_{BW} = B/W$ if T parallel to B; $R_{BW} = W/B$ if T parallel to W

TABLE 4-3

Meyerhof Dimensionless Bearing Capacity and Correction Factors (Data from Meyerhof 1953; Meyerhof 1963)

FACTOR			COHESION (c)	WEDGE (γ)	SURCHARGE (q)	DIAGRAM
BEARING CAPACITY N			N_c	N_γ	N_q	
		$\phi = 0$	5.14	0.00	1.00	
		$\phi > 0$	$(N_q - 1)\cot\phi$	$(N_q - 1)\tan(1.4\phi)$	$N_\phi e^{\pi \tan\phi}$	
CORRECTION ζ	FOUNDATION SHAPE WITH ECCENTRICITY s		ζ_{cs}	$\zeta_{\gamma s}$	ζ_{qs}	
		$\phi = 0$	$1 + 0.2N_\phi \frac{B'}{W'}$	1.0	1.0	
		$\phi > 10$	"	$1 + 0.1N_\phi \frac{B'}{W'}$	$1 + 0.1N_\phi \frac{B'}{W'}$	
		$0 < \phi \le 10$	"	Linear Interpolation Between $\phi = 0$ and $\phi = 10$ Degrees		
	INCLINED LOADING i		ζ_{ci}	$\zeta_{\gamma i}$	ζ_{qi}	
		$\phi = 0$	$\left[1 - \frac{\theta}{90}\right]$	1.0	$\left[1 - \frac{\theta}{90}\right]$	
		$\phi > 0$	$\left[1 - \frac{\theta}{90}\right]^2$	$\theta \le \phi$ $\left[1 - \frac{\theta}{\phi}\right]^2$	$\left[1 - \frac{\theta}{90}\right]^2$	
				$\theta > \phi$ 0.0		
	FOUNDATION DEPTH d		ζ_{cd}	$\zeta_{\gamma d}$	ζ_{qd}	
		$\phi = 0$	$1 + 0.2(N_\phi)^{1/2} \cdot \frac{D}{B}$	1.0	1.0	
		$\phi > 0$	"	$1 + 0.1(N_\phi)^{1/2} \cdot \frac{D}{B}$	$1 + 0.1(N_\phi)^{1/2} \cdot \frac{D}{B}$	
		$0 < \phi \le 10$	"	Linear Interpolation Between $\phi = 0$ and $\phi = 10$ Degrees		

Note: Eccentricity and inclined loading correction factors may not be used simultaneously; factors not used are unity

Nomenclature:
- ϕ = angle of internal friction, degrees
- N_ϕ = $\tan^2(45 + \phi/2)$
- B' = effective width of foundation, $B - 2e_B$, ft
- W' = effective lateral length of foundation, $W - 2e_W$, ft
- B = foundation width, ft
- W = foundation lateral length, ft
- D = foundation depth, ft
- Q = vertical load on foundation, qBW, kips
- q = bearing pressure on foundations, ksf
- T = horizontal load on foundation, right ≤, kips
- R = resultant load on foundation, $(Q^2 + T^2)^{1/2}$
- θ = angle of resultant load with vertical axis, $\cos^{-1}(Q/R)$, degrees
- e_B = eccentricity parallel with B, M_B/Q
- e_W = eccentricity parallel with W, M_W/Q
- M_B = bending moment parallel with B, kips-ft
- M_W = bending moment parallel with W, kips-ft