# General bearing capacity equation

## Modification factors for General bearing capacity equation (based on Vesic, 1975)

| Factor | $S_c$ | $S_q$ | $S_\gamma$ |
|---|---|---|---|
| Foundation shape, $s$ | $S_{cs} = 1 + \frac{B'}{L'}\frac{N_q}{N_c}$ | $S_{qs} = 1 + \frac{B'}{L'}\tan\phi$ | $S_{\gamma s} = 1 - 0.4\frac{B'}{L'}$ |
| Inclined loading, $i$ [1] | $\phi = 0$, $S_{ci} = 1 - \frac{mH}{B'L'cN_c}$<br>$\phi > 0$, $S_{ci} = S_{qi} - \frac{1 - S_{qi}}{N_c \tan\phi}$ | $S_{qi} = \left(1 - \frac{H}{V + B'L'c\cot\phi}\right)^m$ | $S_{\gamma i} = \left(1 - \frac{H}{V + B'L'c\cot\phi}\right)^{m+1}$ |
| Foundation depth, $d$ [2] | $\phi = 0$, $S_{cd} = 1 + 0.4k$<br>$\phi > 0$, $S_{cd} = S_{qd} - \frac{1 - S_{qd}}{N_c \tan\phi}$ | $S_{qd} = 1 + 2\tan\phi\,(1 - \sin\phi)^2 k$ | $S_{\gamma d} = 1$ |
| Surface slope, $\beta$ [3] | $\phi = 0$, $S_{c\beta} = 1 - \frac{2\beta}{\pi + 2}$<br>$\phi > 0$, $S_{c\beta} = S_{q\beta} - \frac{1 - S_{q\beta}}{N_c \tan\phi}$ | $S_{q\beta} = (1 - \tan\beta)^2$ | $S_{\gamma\beta} = (1 - \tan\beta)^2$ [4] |
| Base inclination, $\delta$ [5] | $\phi = 0$, $S_{c\delta} = 1 - \frac{2\delta}{\pi + 2}$<br>$\phi > 0$, $S_{c\delta} = S_{q\delta} - \frac{1 - S_{q\delta}}{N_c \tan\phi}$ | $S_{q\delta} = (1 - \delta\tan\phi)^2$ | $S_{\gamma\delta} = (1 - \delta\tan\phi)^2$ |

[1] $V$ = vertical force; $H$ = horizontal force; $m$ depends on direction of inclined loading $\theta$ relative to long side of the foundation: If force inclined in $B$ direction ($\theta$=90°) $m = m_B = (2+B/L)/(1+B/L)$, if inclined in $L$ direction ($\theta$=0°) $m = m_L = (2+L/B)/(1+L/B)$, and if inclined at angle $\theta$ to $L$ direction $m = m_\theta = m_L\cos^2\theta + m_B\sin^2\theta$.

[2] $k = D/B$ if $D/B \le 1$; $k = \tan^{-1}(D/B)$ if $D/B > 1$.

[3] $\beta$ = inclination below horizontal of the ground surface away from the edge of the foundation (see Figure 10.4 for $\beta < \pi/4$; $\beta$ in radians.

[4] For sloping ground case where $\phi = 0$ $N_\gamma = -2\sin\beta$ must be used in bearing capacity equation.

[5] $\delta$ = inclination from the horizontal of the underside of the foundation (see Figure 10.4); for $\delta < \pi/4$; $\delta$ in radian

## Bearing capacity factors $N_c$ and $N_q$ from Meyerhof (1963) and $N\gamma$ from Davis and Booker (1971)

Values recommended by CFEM

| $\phi$ ° | $N_c$ | $N_q$ | $N_\gamma$ rough | $N_\gamma$ smooth |
|---|---|---|---|---|
| 0 | 5.1 | 1 | 0 | 0 |
| 10 | 8.3 | 2.5 | 0.6 | 0.3 |
| 15 | 11 | 3.9 | 1.3 | 0.8 |
| 20 | 15 | 6.4 | 3.0 | 1.7 |
| 21 | 16 | 7.1 | 3.6 | 2.0 |
| 22 | 17 | 7.8 | 4.2 | 2.4 |
| 23 | 18 | 8.7 | 5.0 | 2.8 |
| 24 | 19 | 9.6 | 5.9 | 3.3 |
| 25 | 21 | 11 | 7.0 | 3.8 |
| 26 | 22 | 12 | 8.2 | 4.5 |
| 27 | 24 | 13 | 9.7 | 5.3 |
| 28 | 26 | 15 | 11 | 6.2 |
| 29 | 28 | 16 | 14 | 7.3 |
| 30 | 30 | 18 | 16 | 8.6 |
| 31 | 33 | 21 | 19 | 10 |
| 32 | 35 | 23 | 22 | 12 |
| 33 | 39 | 26 | 27 | 14 |
| 34 | 42 | 29 | 31 | 17 |
| 35 | 46 | 33 | 37 | 19 |
| 36 | 51 | 38 | 44 | 23 |
| 37 | 56 | 43 | 52 | 27 |
| 38 | 61 | 49 | 61 | 32 |
| 39 | 68 | 56 | 73 | 37 |
| 40 | 75 | 64 | 86 | 44 |

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