

Foundation shape:	Circular			Rectangular
	Spring stiffness K	Damping coefficient C	Effective mass ^(a) M, I, J	Spring stiffness K
Vertical (z)	$\frac{4GR}{1-\nu}$ (b)	$\frac{3.4R^2}{1-\nu} \sqrt{\rho G}$	$\frac{1.08\rho R^3}{1-\nu}$	$\frac{G}{(1-\nu)} \beta_z \sqrt{BL}$ (f)
Horizontal (x)	$\frac{8GR}{2-\nu}$ (c)	$\frac{4.6R^2}{2-\nu} \sqrt{\rho G}$	$\frac{0.76\rho R^3}{2-\nu}$	$2(1+\nu)G\beta_x \sqrt{BL}$ (g)
Rocking (ψ)	$\frac{8GR^3}{3(1-\nu)}$ (d)	$\frac{0.65R^4 \sqrt{\rho G}}{(1-\nu)}$	$\frac{0.64\rho R^5}{1-\nu}$	$\frac{G\beta_\phi BL^2}{1-\nu}$ (h)
Torsion (θ)	$\frac{16GR^3}{3}$ (e)	$1.32R^4 \sqrt{\rho G}$	$0.24\rho R^5$	$\frac{3GJk_T}{(1-\nu)\sqrt{BL}}$ (i)

R = radius of foundation

ρ = soil density

B, L = width and length of rectangular foundation

G = shear modulus

ν = Poisson's ratio

$\beta_n, \beta_z, \beta_\phi$ = coefficients given in Figure 5.34

M = mass of foundation

I = rocking inertia of foundation

J = torsional inertia of foundation

k_T = coefficient given in Table 5.6

C = radiation damping coefficient

References:

(a) Richart et al, 1970

(b) Timoshenko et al, 1951

(c) Bycroft, 1956

(d) Borowicka, 1943

(e) Reissner and Sagoci, 1944

(f) Barkan, 1962

(g) Gorbunon-Possadov and Serebrajanyi, 1961

(h) Newmark and Rosenblueth, 1971

Table 5.5 Foundation properties for a rigid plate on an elastic half-space

Aspect ratio, L/B	k_T				
	$\nu = 0.1$	0.2	0.3	0.4	0.5
1	1.00	0.938	0.868	0.792	0.704
1.5	1.01	0.942	0.864	0.770	0.692
2.0	1.02	0.945	0.870	0.784	0.686
3.0	1.05	0.975	0.906	0.806	0.700
5.0	1.15	1.050	0.950	0.850	0.732
10.0	1.25	1.160	1.040	0.940	0.940

Torsional spring stiffness, $K = \frac{3GJk_T}{(1-\nu)\sqrt{BL}}$

Table 5.6 Values of k_T to calculate the torsional spring stiffness for rectangular foundations (Newmark and Rosenblueth, Fundamentals of Earthquake Engineering, 1971, pp. 98. Adapted by permission of Prentice Hall, Inc. Englewood Cliffs, NJ 07632.

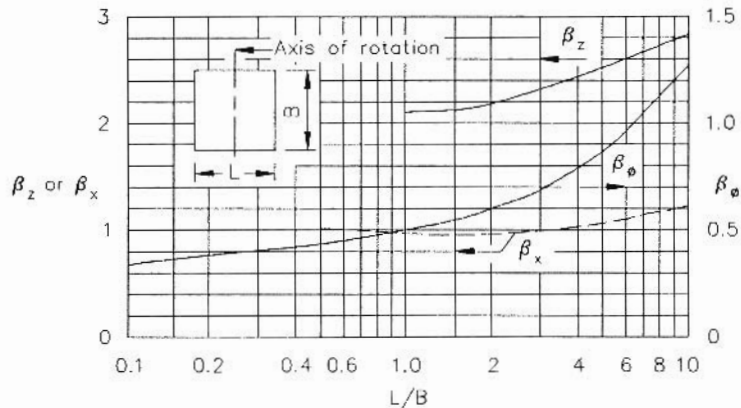


Figure 5.34 Coefficients β_x , β_z and β_ϕ for rectangular foundations (after Whitman and Richart, 1967)