2.4 IS code method:

General shear failure:

$$q_f = CN_cS_cd_ci_c + \gamma DN_qS_qd_qi_q + 0.5B\gamma N_\gamma S_\gamma d_\gamma i_\gamma$$

Local shear failure

$$q_f = \frac{2}{3}CN'_cS_cd_ci_c + \gamma DN'_qS_qd_qi_q + 0.5B\gamma N'_\gamma S_\gamma d_\gamma i_\gamma W'$$

S_c, S_q, S_γ= Shape factor

d_c, d_q, d_γ= Depth factor

i_c, i_q, i_γ= inclination factor

W'=water table factor

Shape	**S_c**	**S_q**	**S_γ**
Strip	1	1	1
Rectangle	$1 + 0.2\frac{B}{L}$	$1 + 0.2\frac{B}{L}$	$1 - 0.4\frac{B}{L}$
Square	1.3	1.2	0.8
Circle	1.3	1.2	0.6

For $\varphi = 0, i_c = i_q = i_\gamma$=1

$$i_c = i_q = \left(1 - \frac{\alpha}{90}\right)^2$$

$$i_\gamma = \left(1 - \frac{\alpha}{\varphi}\right)^2$$

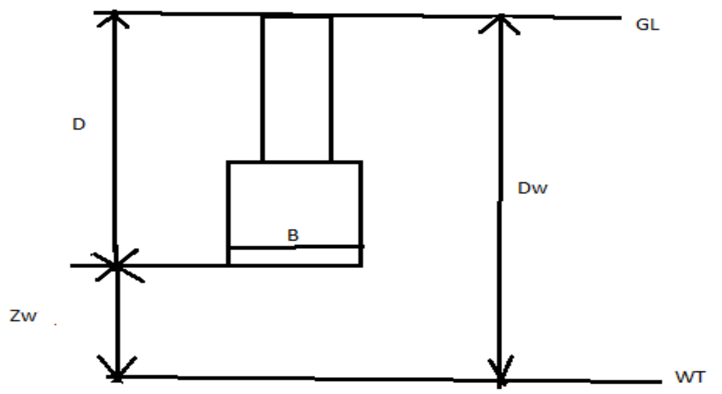
$$N\varphi = \tan^2\left(45 + \frac{\varphi}{2}\right)$$

$$\varphi > 10^0, d_q = d_\gamma = 1 + 0.1(\frac{D_f}{B})\sqrt{N\varphi}$$

$$\varphi < 10^0, d_q = d_\gamma = 1$$

$$d_c = 1 + 0.2\frac{D}{B}\sqrt{N\varphi}$$

Effect of water table(W'):



$$W' = 0.5\left[1 + \frac{(D_w - D)}{B}\right]$$

$$W' = 0.5\left[1 + \frac{Z_w}{B}\right]$$

When Z_w=0,W'=0.5

Z_w=B,W'=1

Table1: Bearing Capacity Factor (Refer IS6403-1981 Page number8)

BEARING CAPACITY FACTORS

φ (Degrees)	N_c	N_q	N_γ
0	5·14	1·00	0·00
5	6·49	1·57	0·45
10	8·35	2·47	1·22
15	10·98	3·94	2·65
20	14·83	6·40	5·39
25	20·72	10·66	10·88
30	30·14	18·40	22·40
35	46·12	33·30	48·03
40	75·31	64·20	109·41
45	138·88	134·88	271·76
50	266·89	319·07	762·89

Problems:

1.A rectangular footing has a size of 1.8mx3m has to transmit the load of a column at a depth of 1.5m. Calculate the safe load which the footing can carry at a factor of safety 3 against shear failures. Use Is code method. The soil has the following Properties.n=40%,G=2.67,w=15%,c=8KN/m^2,Φ=32.5^0

Solution:

$$e = \frac{n}{1-n}$$

$$= \frac{0.4}{1-0.4} = 0.667$$

$$\gamma_d = \frac{G\gamma_w}{1+e}$$

$$= \frac{2.67x9.81}{1+0.667} = 15.71KN/m^3$$

$$\gamma = \gamma_d(1+w)$$

=15.71(1+0.15)

=18.07KN/m^3.

For Φ=32.5^0 for Is Method

N_c=38.3,N_q=25.85and $N\gamma$=35.21

$$q_f = CN_cS_cd_ci_c + \gamma DN_qS_qd_qi_q + 0.5B\gamma N_\gamma S_\gamma d_\gamma i_\gamma$$

For Rectangular:

Shape Factor

$$s_c = 1 + 0.2\frac{B}{L}$$

$$= 1 + 0.2\frac{1.8}{3} = 1.12$$

$$s_q = 1 + 0.2\frac{B}{L}$$

$$= 1 + 0.2\frac{1.8}{3} = 1.12$$

$$s_\gamma = 1 - 0.4\frac{B}{L}$$

$$= 1 - 0.4x\frac{1.8}{3} = 0.76$$

Depth factor:

$$\varphi > 10^0, d_q = d_\gamma = 1 + 0.1(\frac{D_f}{B})\sqrt{N\varphi}$$

$$d_c = 1 + 0.2\frac{D}{B}\sqrt{N\varphi}$$

$i_c = i_q = i_\gamma$=1

$N\varphi = \tan^2\left(45 + \frac{\varphi}{2}\right)$ or $\sqrt{N\varphi} = tan\left(45 + \frac{\varphi}{2}\right)$

$$\sqrt{N\varphi} = tan\left(45 + \frac{32.5}{2}\right) = 1.823$$

$$d_c = 1 + 0.2\frac{1.5}{1.8}x1.823 = 1.304$$

$$d_q = d_\gamma = 1 + 0.1\left(\frac{1.5}{1.8}\right)x1.823 = 1.152$$

$$q_f = 8x38.13x1.12x1.304 + 18.07x1.5x25.85x1.12x1.152 + 0.5x18.07x1.8x35.21x0.76x1.152$$

$$= 445.50 + 904.02 + 501.34$$

$$= 1850.86KN/m^2$$

$$q_{nf} = q_f - \gamma D$$

$$= 1850.86 - 18.07x1.5$$

$$= 1823.75KN/m^2$$

$$q_s = \frac{q_{nu}}{F} + \gamma D$$

$$= \frac{1823.75}{3} + (18.07x1.5)$$

$$= 635.02KN/m^2$$

Safe Load= q_s x area

=635.02x(1.8x3)

=3429KN