PROBLEM 3

GIVEN: FS= 4 Table P.3.1 in the solution

FIND: 1. Find the general bearing capacity
2. The allowable gross vertical load-bearing capacity of the foundation

METHOD: *1.Determine bearing capacity factors, Nc, Nq and Ny using Equation 3.20 or Table 3.3*
2. Determine shape, depth, inclination factors using Equations from Table 3.4
3. Determine q (effective stress) or the bearing surcharge
4. Apply equation 3.19 to find the general bearing capacity
5. Apply factor of safety to find the gross allowable load-bearing capacity

SOLUTION:

1. Given Table on the problem, we can obtain the bearing capacity factors using Table 3.3:

Part	B	L	Df	ϕə	c'	γ	β	Type	Nc	Nq	Ny	
a	4	1E+06	3	0.436	600	110	0	Strip	20.72	10.7	11	English Units
b	2	1E+06	1	0.524	0	17	0	Strip	30.14	18.4	22	SI
c	3	3	2	0.524	0	16.5	0	Square	30.14	18.4	22	SI

*Obs: Since a/b are strip foundations, L=1

2. For the shape, depth and inclination factors we have:

2.1. Shape

		a	b	c
Fcs =	1+ (B/L)* (Nq/Nc) =	1	1	1.61
Fqs =	1 + (B/L) * tan f' =	1	1	1.577
Fys =	1 - 0.4 (B/L) =	1	1	0.6

2.2 Depth *

*Df/B <= 1 or > 1 changes the formula
* Fyd=1
* Consider ϕ=0 or >0

		Thus For f>0		
	Df/B	Fcd	Fqd	Fyd
a	0.75	1.3186	1.2887	1
b	0.5	1.1526	1.1443	1
c	0.667	1.2035	1.1925	1

2.3 Inclination factors

	Fci	Fqi	Fyi
a	1	**1**	1

3. Surcharge Bearing Stress, q=Df*y

	q	
a	330	lb/ft^2
b	17	‹N/m^2
c	33	‹N/m^2

b	1	**1**	1
c	1	**1**	1

4. General Bearing Capacity

$qu = c'.Nc.Fcs.Fcd.Fci + q.Nq.Fqs.Fqd.Fqi + 0.5y.B.Ny.Fys.Fyd.Fyi$ EQ 3.19

a	23320
b	738.7
c	1475

5. Allowable Bearing Capacity

	qu/FS
a	5830
b	184.7
c	368.7

PROBLEM 5

GIVEN: FS= 3 And values on table on the solution

FIND: 1. Find the general bearing capacity
2. The allowable gross vertical load-bearing capacity of the foundation

METHOD: *1.Determine bearing capacity factors, Nc, Nq and Ny using Equation 3.20 or Table 3.3*
2. Determine shape, depth, inclination factors using Equations from Table 3.4
3. Determine q (effective stress) or the bearing surcharge including the wet comp
4. Apply equation 3.19 to find the general bearing capacity
5. Apply factor of safety to find the gross allowable load-bearing capacity
6. Determine the Allowable load

SOLUTION:

1. Given Table on the problem, we can obtain the bearing capacity factors using Table 3.3:

Part	B	L	Df	ϕ'	c'	γ	β	Type	Nc	Nq	Ny	
a	2	3	1.5	0.436	70	17	0	Strip	20.72	10.7	11	SI

2. For the shape, depth and inclination factors we have:

2.1. Shape

		a
Fcs =	1+ (B/L)* (Nq/Nc) =	1.343
Fqs =	1 + (B/L) * tan f' =	1.311

2.3 Inclination factors

	Fci	Fqi	Fyi
a	1	**1**	1

Fys = 1 - 0.4 (B/L) = 0.733

2.2 Depth

		Thus For f>0		
	Df/B	Fcd	Fqd	Fyd
a	0.75	1.2573	1.2332	1

3. Surcharge Bearing Stress, q=D1*y+D2y' D1= 1 m D2= 0.5 m
y'= 9.7 kN/m2

	q
a	21.85 kN/m^2

4. General Bearing Capacity EQ 3.19

	qu	
a	2961	**kN/m^2**

5. Allowable Bearing Capacity

qu/FS
qall 987.1 **kN/m^2**

6. Allowable Load:

Qall=qall*B*L = **5922.5** kN

PROBLEM 7

GIVEN: Es= 1020 kN/m^2 Poisson's ration, μs= 0.35

And, Gs= Es/2(1+μs) = 377.8 kN/m^2 (EQ page 155)

FIND: 1. Find the ultimate bearing capacity taking in account the soil compressibility

METHOD: *1.Determine bearing capacity factors, Nc, Nq and Ny using Equation 3.20 or Table 3.3*
2. Determine shape, depth, inclination factors using Equations from Table 3.4
3. Determine q (effective stress) or the bearing surcharge
4. Determine the compressibility factors, Fcc, Fqc and Fyc
5. Apply equation 3.27 (Vesic 1973) in order to determine qu (ultimate bearing capacity)

SOLUTION:

1. Given Table on the problem, we can obtain the bearing capacity factors using Table 3.3:

GIVEN	B	L	Df	ϕ'	c'	γ	β	Type	Nc	Nq	Ny	
PROBLEM	1	1.5	1	0.436	50	17	0	Rect	20.72	10.7	11	SI

2. For the shape, depth and inclination factors we have:

2.1. Shape

		a
Fcs =	1+ (B/L)* (Nq/Nc) =	1.343
Fqs =	1 + (B/L) * tan f' =	1.311
Fys =	1 - 0.4 (B/L) =	0.733

2.3 Inclination factors

	Fci	Fqi	Fyi
a	1	**1**	1

2.2 Depth

		Thus For f>0		
	Df/B	Fcd	Fqd	Fyd
a	1	1.3431	1.3109	1

3. Surcharge Bearing Stress, q=Df*y

	q
a	17 kN/m^2

4. Compressibility Factors EQ 3.28

We need q' (effective overburden at a Df + B/2 length) q'= y*(Df+B/2) = 25.5 kN/m^2
Determining the rigidity index, Ir: Ir= Gs/c' + q'tanf' = 6.24 EQ 3.28
Determining the critical rigidity index, Ir(cr) EQ 3.29:

Ir(cr)= 55.47 N1= 3 Angle 0.567 = 0.567

Since Ir(cr) > Ir

Fyc= Fqc = 0.417 Fcc= 0.357

4. General Bearing Capacity EQ 3.27

	qu	
a	825.3	**kN/m^2**

PROBLEM 8

GIVEN: FS= 4 And values on table on the solution

Eccentrically loaded foundation shown in Figure P3.8

FIND: 1. Find the general bearing capacity

2. The allowable load

METHOD: *1. Determine bearing capacity factors, Nc, Nq and Ny using Equation 3.20 or Table 3.3*
2. Determine shape, depth, inclination factors using Equations from Table 3.4
3. Determine q (effective stress) or the bearing surcharge including the wet comp
4. Apply equation 3.19 to find the general bearing capacity
5. Apply factor of safety to find the gross allowable load-bearing capacity
6. Determine the Allowable load

SOLUTION: e= 0.1 m

1. Given Table on the problem, we can obtain the bearing capacity factors using Table 3.3:

Part	B	L	Df	ϕ'	c'	γ	β	B'=L'	Nc	Nq	Ny	
a	1.5	1.5	0.8	0.559	0	17	0	1.3	20.72	10.7	11	SI

2. For the shape, depth and inclination factors we have:

2.1. Shape

		a
Fcs =	1+ (B/L)* (Nq/Nc) =	1.514
Fqs =	1 + (B/L) * tan f' =	1.625
Fys =	1 - 0.4 (B/L) =	0.6

2.3 Inclination factors

	Fci	Fqi	Fyi
a	1	**1**	1

2.2 Depth

		Thus For f>0		
	Df/B	Fcd	Fqd	Fyd
a	0.533	1.1587	1.1473	1

4. General Bearing Capacity EQ 3.19

	qu	
a	342.4	**kN/m^2**

3. Surcharge Bearing Stress, q=D1*γ+D2γ'

	q	
a	13.6	kN/m^2

5. Allowable Load

Effective Area, A' = 1.95
Qult= 667.7 kN

Qall= 166.9 kN

PROBLEM 13

GIVEN: FS= 3 And values on table on the solution

Two-Way Eccentrically loaded foundation shown in Figure P3.19

FIND: 1. Find the general bearing capacity

2. The allowable load

METHOD: *1. Determine bearing capacity factors, Nc, Nq and Ny using Equation 3.20 or Table 3.3*
2. Determine shape, depth, inclination factors using Equations from Table 3.4
3. Determine q (effective stress) or the bearing surcharge including the wet comp
4. Apply equation 3.19 to find the general bearing capacity
5. Apply factor of safety to find the gross allowable load-bearing capacity
6. Determine the Allowable load

SOLUTION: eB= 0.12 m eL= 0.36 m

1. Given Table on the problem, we can obtain the bearing capacity factors using Table 3.3:

Part	B	L	Df	ϕ'	c'	γ	β	B'=L'	Nc	Nq	Ny	
a	1.2	1.8	1	0.611	0	17	0	0.96	20.72	10.7	11	SI

Need to determine the ratios to find what case the effective lengths fall, thus:
eL/L= 1/5 eB/B= 0.1 With these values we use CASE II

2. For the shape, depth and inclination factors we have:

2.1. Shape

		a
Fcs =	1+ (B/L)* (Nq/Nc) =	1.343
Fqs =	1 + (B/L) * tan f' =	1.467
Fys =	1 - 0.4 (B/L) =	0.733

2.3 Inclination factors

	Fci	Fqi	Fyi
a	1	**1**	1

2.2 Depth

		Thus For f>0		
	Df/B	Fcd	Fqd	Fyd
a	0.833	1.2268	1.2122	1

4. General Bearing Capacity EQ 3.19

	qu	
a	387.3	**kN/m^2**

3. Surcharge Bearing Stress, q=D1*γ+D2γ'

	q	
a	17	kN/m^2

5. Effective Lengths & Area (CASE II)

L1= 1.575 L2= 0.4

A'= 1.188

B'= 0.754 L'= 1.58

5. Allowable Load

Effective Area, A' = 1.188

Qult=	460.1	kN
Qall=	153.4	kN