

Scilab Textbook Companion for  
Principles Of Foundation Engineering  
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# Book Description

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Scilab numbering policy used in this document and the relation to the above book.

**Exa** Example (Solved example)

**Eqn** Equation (Particular equation of the above book)

**AP** Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

# Contents

List of Scilab Codes	4
1 Geotechnical Properties of Soil	5
2 Natural Soil Deposits and Subsoil Exploration	10
3 Shallow Foundations	12
4 Ultimate Bearing Capacity of Shallow Foundations	18
5 Shallow Foundations Allowable Bearing Capacity and Settlement	23
6 Mat Foundations	31
7 Lateral Earth Pressure	36
8 Retaining Walls	41
9 Sheet Pile Piles	50
10 Braced Cuts	58
11 Pile Foundations	61

<b>12 Drift Shaft Foundations</b>	<b>71</b>
<b>13 Foundations on Difficult Soils</b>	<b>78</b>
<b>14 Soil Improvement and Ground Modification</b>	<b>81</b>

# List of Scilab Codes

Exa 1.1	1	5
Exa 1.2	2	6
Exa 1.3	3	6
Exa 1.4	4	7
Exa 1.5	5	7
Exa 1.6	6	7
Exa 1.7	7	8
Exa 1.8	8	9
Exa 2.1	1	10
Exa 3.1	1	12
Exa 3.2	2	12
Exa 3.3	3	13
Exa 3.4	4	14
Exa 3.5	5	15
Exa 3.6	6	16
Exa 3.7	7	16
Exa 3.8	8	17
Exa 4.1	1	18
Exa 4.2	2	19
Exa 4.3	3	19
Exa 4.4	4	20
Exa 4.5	5	21
Exa 4.6	6	21
Exa 4.7	7	21
Exa 4.8	8	22
Exa 5.1	1	23
Exa 5.2	2	24
Exa 5.3	3	24

Exa 5.4	4	25
Exa 5.5	5	26
Exa 5.6	6	26
Exa 5.7	7	27
Exa 5.8	8	27
Exa 5.9	9	28
Exa 5.10	10	28
Exa 5.11	11	29
Exa 6.1	1	31
Exa 6.2	2	31
Exa 6.3	3	32
Exa 6.4	4	32
Exa 6.5	5	33
Exa 6.6	6	33
Exa 7.1	1	36
Exa 7.2	2	36
Exa 7.3	3	37
Exa 7.4	4	38
Exa 7.5	5	38
Exa 7.6	6	39
Exa 7.7	7	40
Exa 8.1	1	41
Exa 8.2	2	43
Exa 8.3	3	43
Exa 8.4	4	44
Exa 8.5	5	46
Exa 8.6	6	46
Exa 8.7	7	48
Exa 9.1	1	50
Exa 9.2	2	51
Exa 9.3	3	52
Exa 9.4	4	53
Exa 9.5	5	54
Exa 9.6	6	55
Exa 9.7	7	56
Exa 9.8	4	56
Exa 10.1	1	58
Exa 10.2	2	59

Exa 10.3	3	59
Exa 10.4	4	60
Exa 11.1	1	61
Exa 11.2	2	62
Exa 11.3	3	62
Exa 11.4	4	63
Exa 11.5	5	64
Exa 11.6	6	65
Exa 11.7	7	65
Exa 11.8	8	66
Exa 11.9	9	67
Exa 11.10	10	68
Exa 11.11	11	68
Exa 11.12	12	69
Exa 12.1	1	71
Exa 12.2	2	72
Exa 12.3	3	72
Exa 12.4	4	73
Exa 12.5	5	73
Exa 12.6	6	74
Exa 12.7	7	75
Exa 12.8	8	76
Exa 13.1	1	78
Exa 13.2	2	78
Exa 13.3	3	79
Exa 14.1	1	81
Exa 14.2	2	82
Exa 14.3	3	82



# Chapter 1

## Geotechnical Properties of Soil

Scilab code Exa 1.1 1

```
1 //example 1.1
2 clc; funcprot(0);
3 V=0.25; // ft^3
4 W=30.8; //lb
5 Wd=28.2; // weight dried lb
6 Gs=2.67;
7 Gammaw=62.4; //lb/ft^3
8 Gamma=W/V;
9 disp(Gamma, "moist unit weight in lb/ft^3")
10 w=(W-Wd)/W;
11 disp(w*100, "moisture content in %");
12 Gammad=Wd/V;
13 disp(Gammad, "dry unit weight in lb/ft^3")
14 Vs=Wd/Gs/Gammaw;
15 Vv=V-Vs;
16 e=Vv/Vs;
17 disp(e, "void ratio");
18 n=e/(1+e);
19 disp(n, "porosity");
20 Vw=(W-Wd)/Gammaw;
21 S=Vw/Vv;
```

```
22 disp(S*100," saturation in %");
```

---

### Scilab code Exa 1.2 2

```
1 //example 1.2
2 clc; funcprot(0);
3 e=0.72;
4 w=12/100; //moisture content
5 Gs=2.72;
6 Gammaw=9.81; //kN/m^3
7 Gammad=Gs*Gammaw/(1+e);
8 disp(Gammad,"dry unit weight in kN/m^3");
9 Gamma=Gs*Gammaw*(1+w)/(1+e);
10 disp(Gamma,"moist unit weight in kN/m^3");
11 Gammasat=(Gs+e)*Gammaw/(1+e);
12 wa=Gammasat-Gamma; //water added
13 disp(wa,"water added in kN/m^3");
```

---

### Scilab code Exa 1.3 3

```
1 //example 1.3
2 clc; funcprot(0);
3 gmax=17.1; // Gammadmax
4 Dr=0.7;
5 w=8/100; //moisture content
6 gmin=14.2; //Gammadmin
7 deff('y=f(x)', 'y=(x-14.2)/(17.1-14.2)*17.1/x-0.7');
8 [x, v, info]=fsolve(16,f); //solving for gammad
9 Gamma=x*(1+w);
10 disp(Gamma,"moist unit weight in kN/m^3");
```

---

#### Scilab code Exa 1.4 4

```
1 //example 1.4
2 clc; funcprot(0);
3 F200=30;
4 PI=8;
5 GI=0.01*(F200-15)*(PI-10);
6 if GI<0 then
7     GI=0;
8     disp("the soil is A-2-4(0)")
9 end
```

---

#### Scilab code Exa 1.5 5

```
1 //example 1.5
2 clc; funcprot(0);
3 F200=41;
4 LL=31;
5 PI=12;
6 if 100-F200>50 then
7     disp("soil is coarse grained")
8 end
9 //from table 1.5 and 1.6
10 disp("soil is SC");
```

---

#### Scilab code Exa 1.6 6

```
1 //example 1.6
2 clc; funcprot(0);
3 Gammad=14.5;
4 Gammasat=17.2;
5 Gammaw=9.81;
```

```

6 printf("Point \t Sigma (kN/m^2)\t u(kN/m^2)\t
   sigmadash=sigma-u (kN/m^2)\n");
7
8 printf("  A\t  %d\t  \t  %d\t\t %d \n",0,0,0);
9 printf("  B\t%.2 f\t \t%.2 f\t\t %.2 f \n",4*Gammad
   ,0,4*Gammad-0);
10 printf("  C\t%.2 f\t \t%.2 f\t\t %.2 f \n",4*Gammad+5*
   Gammasat ,5*Gammaw ,4*Gammad+5*Gammasat-5*Gammaw);

```

---

### Scilab code Exa 1.7 7

```

1 //example 1.7
2 clc; funcprot(0);
3 //parta
4 e1=0.92;
5 e2=0.86;
6 Hc=2.8;
7 s2=212; //sigma2dash
8 s1=140; //sigma1dash
9 Cc=(e1-e2)/log10(s2/s1);
10 Sc=Cc*Hc/(1+e1)*log10(s2/s1);
11 disp(Sc*1000,"consolidated depth in mm");
12 //part b
13 Sct=40;
14 T50=0.197;
15 t=4.5;
16 Cr=T50*12.7^2/t;
17 U=Sct/Sc*100/1000;
18 H=Hc/2;
19 Tv=%pi/4*U^2/100^2;
20 t=Tv*H^2/Cr*1000^2/60/24;
21 disp(t,"time required in days");

```

---

### Scilab code Exa 1.8 8

```
1 //example 1.8
2 clc; funcprot(0);
3 Cv=7.061;
4 tc=15*24*60;
5 H=2.8/2*1000;
6 Scmax=87.5; // consolidation
7 Tc=Cv*tc/H^2;
8 tv=31.6*24*60;
9 Tv=Cv*tv/H^2;
10 //from figure 1.28
11 Sct=Scmax*0.36;
12 disp(Sct,"consolidation in 31.6 days in mm");
```

---

## Chapter 2

# Natural Soil Deposits and Subsoil Exploration

Scilab code Exa 2.1 1

```
1 //example 2.1
2 clc; funcprot(0);
3 Distance=[2.5,5,7.5,10,15,20,25,30,35,40,50];
4 Time
    =10^-3*[11.2,23.3,33.5,42.4,50.9,57.2,64.4,68.6,71.1,72.1,75.5]

5 //part1
6 distance=5.25;
7 time=23e-3;
8 v1=distance/time;
9 disp(v1,"speed in m/s");
10 //part2
11 distance=11;
12 time=13.5e-3;
13 v2=distance/time;
14 disp(v2,"speed in m/s");
15 //part3
16 distance=14.75;
17 time=3.5e-3;
```

```
18 v3=distance/time;
19 disp(v3,"speed in m/s");
20 plot(Distance,Time);
21 xtitle("distance vs time","Distance in m","time in s
    ");
22 //part4
23 xc=10.4;
24 Ta=65e-3;
25 Z1=1/2*sqrt((v2-v1)/(v2+v1))*xc;
26 disp(Z1,"thickness of layer 1 in m");
27 Z2=1/2*(Ta-2*Z1*sqrt(v3^2-v1^2)/v3/v1)*v3*v2/sqrt(v3
    ^2-v2^2);
28 disp(Z2,"thickness of layer 2 in m");
```

---

# Chapter 3

## Shallow Foundations

Scilab code Exa 3.1 1

```
1 //example 3.1
2 clc; funcprot(0);
3 Nc=17.69;
4 Nq=7.44;
5 Ny=3.64;
6 q=3*115;
7 Gamma=115; //lb/ft^3
8 c=320;
9 B=5; //ft
10 FS=4; //factor of safety
11 qu=1.3*c*Nc+q*Nq+0.4*Gamma*B*Ny
12 qall=qu/FS; //q allowed
13 Q=qall*B^2;
14 disp(Q,"allowable gross load in lb");
```

---

Scilab code Exa 3.2 2

```
1 //example 3.2
```



```

2  clc; funcprot(0);
3  Gamma=105; //lb/ft ^3
4  Gammasat=118; //lb/ft ^3
5  FS=3;
6  pa=2014.125; //lb/ft ^2
7  Depth=[5,10,15,20,25];
8  N60=[4,6,6,10,5];
9  sigmao=[0,0,0,0,0];
10 phi=[0,0,0,0,0]
11 Gammaw=62.4;
12 s=0;
13 printf("depth (ft)\tN60\t \tstress(lb/ft^2)\t phi(
    degrees)\n")
14 for i=1:5
15     sigmao(i)=2*Gamma+(Depth(i)-2)*(Gammasat-Gammaw)
    ;
16     phi(i)=sqrt(20*N60(i)*sqrt(pa/sigmao(i)))+20;
17     printf(" %.2f\t      %.2f\t\t      %.2f \t%.2f \n
    ",Depth(i),N60(i),sigmao(i),phi(i));
18 avgphi=phi(i)/5+s;
19 s=avgphi;
20 end
21 disp(round(avgphi),"average friction angle in
    degrees");
22 //using graph get the values of other terms in terms
    of B and solve for B
23 deff('y=f(x)', 'y=-150000/x^2+5263.9+5527.1/x+228.3*x
    ');
24 [x, v, info ]=fsolve(4,f);
25 disp(x,"the width in ft");

```

---

### Scilab code Exa 3.3 3

```

1  //example 3.3
2  clc; funcprot(0);

```

```

3 phi=25; // degrees
4 Es=620; //kN/m^2
5 Gamma=18; //kN/m^2
6 Df=0.6;
7 B=0.6;
8 L=1.2;
9 Fqc=0.347;
10 Nq=10.66;
11 Nc=20.72;
12 Ngamma=10.88;
13 mu=0.3;
14 Fyd=1;
15 c=48; //kN/m^2
16 q=Gamma*(Df+B/2);
17 Ir=Es/(2*(1+mu)*(c+q*tan(phi*%pi/180)));
18 disp(Ir,"value of Ir");
19 Fcc=Fqc-(1-Fqc)/(Nq*tan(phi*%pi/180));
20 Fcs=1+Nq/Nc*B/L;
21 Fqs=1+B/L*tan(phi*%pi/180);
22 Fys=1-0.4*B/L;
23 Fcd=1+0.4*Df/B;
24 Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B
    ;
25 q1=0.6*18;
26 Fyc=Fqc;
27 qu=c*Nc*Fcs*Fcd*Fcc+q1*Nq*Fqs*Fqd*Fqc+1/2*Gamma*
    Ngamma*Fys*Fyd*Fyc;
28 disp(qu,"ultimate bearing capacity in kN/m^2");

```

---

#### Scilab code Exa 3.4 4

```

1 //example 3.4
2 clc; funcprot(0);
3 q=110*4; //lb/ft^2
4 Nq=33.3;

```

```

5 phi=35;
6 Df=4;
7 B=6;
8 Gamma=110;
9 Ngamma=48.03;
10 B1=6-2*0.5;
11 Fqi=1;
12 Fyi=1;
13 Fyd=1;
14 Fqs=1;
15 Fys=1;
16 Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B
    ;
17 qu=q*Nq*Fqs*Fqd*Fqi+1/2*B1*Gamma*Ngamma*Fys*Fyd*Fyi;
18 Qult=B1*1*qu;
19 disp(Qult,"ultimate bearing capacity in lb/ft");
20 disp(Qult/2000,"ultimate bearing capacity in ton/ft"
    );

```

---

### Scilab code Exa 3.5 5

```

1 //example 3.5
2 clc; funcprot(0);
3 e=0.5;
4 B=6;
5 k=e/B;
6 Gamma=110;
7 q=440;
8 disp("get the values of Nqe and Nye from the figure
    from the value of e/B");
9 Nye=26.8;
10 Nqe=33.4;
11 Qult=B*1*(q*Nqe+1/2*Gamma*B*Nye);
12 disp(Qult,"ultimate bearing capacity in lb/ft");
13 disp(Qult/2000,"ultimate bearing capacity in ton/ft")

```

);

---

### Scilab code Exa 3.6 6

```
1 //example 3.6
2 clc; funcprot(0);
3 Df=0.7;
4 //from table
5 Nq=18.4;
6 Ny=22.4;
7 q=12.6;
8 phi=30; //angle
9 L=1.5;
10 Fyd=1;
11 Gamma=18;
12 L1=0.85*1.5;
13 L2=0.21*1.5;
14 B=1.5;
15 A=1/2*(L1+L2)*B;
16 B1=A/L1; //B'
17 Fqs=1+B1/L1*tan(phi*%pi/180);
18 Fys=1-0.4*B1/L1;
19 Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B
   ;
20 Qult=A*(q*Nq*Fqs*Fqd+1/2*Gamma*B1*Ny*Fys*Fyd);
21 disp(Qult,"ultimate load in kN");
```

---

### Scilab code Exa 3.7 7

```
1 //example 3.7
2 clc; funcprot(0);
3 e=0.15;
4 B=1.5;
```

```

5 Fqs=1;
6 L=1.5;
7 Gamma=18;
8 q=0.7*18;
9 //from table
10 Nqe=18.4;
11 Nye=11.58;
12 Fys=1+(2*e/B-0.68)*(B/L)+(0.43-3/2*e/B)*(B/L)^2;
13 Qult=B*L*(q*Nqe*Fqs+1/2*Gamma*Nye*Fys);
14 disp(Qult,"ultimate load in kN");

```

---

#### Scilab code Exa 3.8 8

```

1 //example 3.8
2 clc; funcprot(0);
3 q=16;
4 Nqei=14.2;
5 Gamma=16
6 B=1.5;
7 Nyet=20;
8 Qult=B*(Nqei*q+1/2*Gamma*B*Nyet);
9 disp(Qult,"ultimate load in kN/m");

```

---

## Chapter 4

# Ultimate Bearing Capacity of Shallow Foundations

Scilab code Exa 4.1 1

```
1 //example 4.1
2 clc; funcprot(0);
3 FS=4;
4 q=110*2;
5 Nq=90;
6 Ny=50;
7 Gamma=110;
8 m1=0.34;
9 B=2.5;
10 L=2.5;
11 H=1.5;
12 phi=35;
13 m2=0.45;
14 Fqs=1-0.34*B/L;
15 Fys=1-0.45*B/L;
16 qu=q*Nq*Fqs+1/2*Gamma*Ny*Fys*B;
17 Qall=qu*B^2/FS;
18 disp(Qall,"bearing load in lb");
```

---

### Scilab code Exa 4.2 2

```
1 //example 4.2
2 clc; funcprot(0);
3 FS=3;
4 cu=72;
5 q=18;
6 B=1;
7 H=0.25;
8 qu=5.14*(1+(0.5*B/H-0.707)/5.14)*cu+q;
9 qall=q/FS;
10 disp(qall,"bearing capacity of soil in kN/m^2");
```

---

### Scilab code Exa 4.3 3

```
1 //example 4.3
2 clc; funcprot(0);
3 k=0; //B/L;
4 c2=30;
5 Gamma=17.5;
6 H=1.5;
7 Df=1.2;
8 H=1.5;
9 B=2.0;
10 Ks=2.5;
11 phi=40;
12 pi=%pi;
13 qu=(1+0.2*k)*5.14*c2+(1+k)*Gamma*H^2*(1+2*Df/H)*Ks*
    tan(phi*pi/180)/B+Gamma*H;
14 Qu=qu*B;
15 disp(Qu,"bearing capacity in kN/m");
```

```

16 disp("there is slight variation due to rounding off
      error")
17 //soil 2
18 Ny=109.4;
19 Nq=64.2;
20 Fqs=1;
21 Fys=1;
22 qt=Gamma*Df*Nq*Fqs+1/2*Gamma*Ny*Fys*B;
23 disp(qt,"bearing capacity in kN/m^2");

```

---

#### Scilab code Exa 4.4 4

```

1 //example 4.4
2 clc; funcprot(0);
3 B=1;
4 L=1.5;
5 c2=48;
6 ca=108;
7 D=1;
8 H=1;
9 Gamma=16.8;
10 FS=4;
11 qu=(1+0.2*B/L)*5.14*c2+(1+B/L)*2*ca*H/B+Gamma*D;
12 c1=120;
13 gamma1=16.8;
14 Df=1;
15 qt=(1+0.2*B/L)*5.14*c1+gamma1*Df;
16 disp(qt,"qt in kN/m^2");
17 disp("no need to calculate qt since it is not useful
      for calculation")
18 disp(qu/FS,"allowable shear stress in kN/m^2");
19 disp(qu/FS*1*1.5,"allowable load in kN");
20 clear()

```

---



#### Scilab code Exa 4.5 5

```
1 //example 4.5
2 clc; funcprot(0);
3 c=50;
4 //from table
5 Ncq=6.3;
6 FS=4;
7 qu=c*Ncq;
8 qall=qu/4;
9 disp(qall," allowed shear stress in kN/m^2");
```

---

#### Scilab code Exa 4.6 6

```
1 //example 4.6
2 clc; funcprot(0);
3 Gamma=16.8;
4 B=1.5;
5 //from table
6 Nyq=120;
7 qu=1/2*Gamma*B*Nyq;
8 disp(qu," shear stress in kN/m^2");
```

---

#### Scilab code Exa 4.7 7

```
1 //example 4.7
2 clc; funcprot(0);
3 phi=35;
4 Df=1.5;
```

```

5 B=1.5;
6 Gamma=17.4;
7 A=%pi/4*Df^2;
8 m=0.25;
9 Ku=0.936;
10 Fq=1+2*(1+m*Df/B)*Df/B*Ku*tan(phi*%pi/180);
11 Qu=Fq*Gamma*A*Df;
12 disp(Qu,"bearing capacity in kN");

```

---

#### Scilab code Exa 4.8 8

```

1 //example 4.8
2 clc; funcprot(0);
3 cu=52;
4 B=1.5;
5 L=3;
6 k=0.107*cu+2.5;
7 disp(k,"Df/B of square");
8 A=L*B;
9 Beta=0.2;
10 Gamma=18.9;
11 Df=1.8;
12 Qu=A*(Beta*(7.56+1.44*B/L)*cu+Gamma*Df);
13 disp(Qu,"ultimate shear force in kN");

```

---

## Chapter 5

# Shallow Foundations Allowable Bearing Capacity and Settlement

Scilab code Exa 5.1 1

```
1 //example 5.1
2 clc; funcprot(0);
3 //first solution
4 B1=2.5;
5 B2=B1;
6 z=12.5;
7 L1=5;
8 L2=L1;
9 m=B1/z;
10 n=B2/z;
11 //from table of tthe values using m,n
12 q=2000;
13 I=0.0328;
14 deltasigma=q*4*I;
15 disp(deltasigma,"change in pressure in lb/ft^2");
16 //second solution
17 Ic=0.131;//from table
```

```
18 deltasigma=q*Ic;
19 disp(deltasigma,"change in pressure in lb/ft^2");
```

---

### Scilab code Exa 5.2 2

```
1 //example 5.2
2 clc; funcprot(0);
3 qo=100;
4 H1=3;
5 H2=5;
6 //from table
7 IaH2=0.126;
8 IaH1=0.175;
9 deltasigma=qo*((H2*IaH2-H1*IaH1)/(H2-H1));
10 disp(deltasigma,"change in pressure in kN/m^2");
11 TS=4*deltasigma;
12 disp(TS,"total change in pressure in kN/m^2");
```

---

### Scilab code Exa 5.3 3

```
1 //example 5.3
2 clc; funcprot(0);
3 H=7;
4 Gamma=17.5;
5 q0=Gamma*H
6 disp(q0,"pressure change in kN/m^2");
7 //part2
8 //from figure
9 Ileftside=0.445;
10 Irightside=0.445;
11 deltasigma=q0*(Ileftside+Irightside);
12 disp(deltasigma,"change in stress in kN/m^2");
13 //partc
```

```

14 //from figure 5.11
15 I=0.24; //I'
16 Dsigma1=43.75*I; //deltasigma1
17 I2=0.495; //I'
18 Dsigma2=I2*q0; //deltasigma2
19 I3=0.335; //I'
20 Dsigma3=I3*78.75; //deltasigma3
21 Dsigma=Dsigma1+Dsigma2-Dsigma3;
22 disp(Dsigma,"total stress increase in A in kN/m^2");

```

---

#### Scilab code Exa 5.4 4

```

1 //example 5.4
2 clc; funcprot(0);
3 zbar=5;
4 mus=0.3;
5 F1=0.641;
6 F2=0.031;
7 z1=2;
8 z2=1;
9 z3=2;
10 Es1=10000;
11 Es2=8000;
12 Es3=12000;
13 qo=150;
14 //from table
15 If=0.709;
16 Es=(Es1*z1+Es2*z2+Es3*z3)/zbar;
17 disp(Es,"modulus of elasticity in kN/m^2");
18 Is=F1+(2-mus)/(1-mus)*F2;
19 Sc=qo*(1/Es-mus^2/Es)*Is*If*2;
20 Scrigid=0.93*Sc;
21 disp(Scrigid*1000,"settlement in mm");

```

---

### Scilab code Exa 5.5 5

```
1 //example 5.5
2 clc; funcprot(0);
3 B=5;
4 L=10;
5 Ef=2.3e6;
6 Eo=1400;
7 k=25;
8 t=1.0;
9 mus=0.3;
10 Df=5;
11 qo=5000;
12 Ig=0.69;
13 Be=sqrt(4*B*L/%pi);
14 If=%pi/4+1/(4.6+10*(Ef/(Eo+2*Be/2*k))*(2*t/Be)^3);
15 Ie=1-1/(3.5*exp(1.22*mus-0.4)*(Be/Df+1.6));
16 Se=qo*Be*Ig*If*Ie/Eo*(1-mus^2)/144;
17 disp(Se*12,"settlement in inches");
```

---

### Scilab code Exa 5.6 6

```
1 //example 5.6
2 clc; funcprot(0);
3 q=3.06;
4 qbar=25;
5 C1=1-0.5*(q/(qbar-q));
6 Sum=0;
7 C2=1+0.2*log10(10/0.1);
8 L=[1, 2, 3, 4, 5];
9 Dz=[48, 48, 96, 48, 144];
10 Es=[750, 1250, 1250, 1000, 2000];
```

```
11 z=[24, 72, 144, 216, 312];
12 Iz=[0.275, 0.425, 0.417, 0.292, 0.125];
13 printf("Layer No.\t deltaz (in)\t Es(lb/in^2)\t z to
    the middle of the layer (in) Iz at the middle
    of the layer Iz/delta(z) \n");
14 for i=1:5
15     k(i)=Iz(i)/Es(i)*Dz(i);
16     printf("%.2f\t \t %.2f\t\t %.2f\t\t %.2f \t\t\t\t\t
    t\t\t\t %.2f\t\t\t\t %.4f \n ",L(i),Dz(i),Es(i)
    ),z(i),Iz(i),k(i));
17     Sum=Sum+k(i);
18 end
19 Se=C1*C2*(qbar-q)*Sum;
20 disp(Se,"settlement in inches");
```

---

#### Scilab code Exa 5.7 7

```
1 //example 5.8
2 clc; funcprot(0);
3 Df=1;
4 B=1.75;
5 qnet=120;
6 N60=10;
7 Fd=1+0.33*Df/B;
8 Se=2*qnet/N60/Fd*(B/(B+0.3))^2;
9 disp(Se,"settlement in mm");
```

---

#### Scilab code Exa 5.8 8

```
1 //example 5.8
2 clc; funcprot(0);
3 Df=1;
4 B=1.75;
```

```

5 qnet=120;
6 N60=10;
7 Fd=1+0.33*Df/B;
8 Se=2*qnet/N60/Fd*(B/(B+0.3))^2;
9 disp(Se,"settlement in mm");

```

---

### Scilab code Exa 5.9 9

```

1 //example 5.9
2 clc; funcprot(0);
3 Ny=23.76;
4 Nq=16.51;
5 q=3*110;
6 Gamma=110;
7 B=4;
8 Nqe=0.63*Nq;
9 Nye=0.4*Ny;
10 que=q*Nqe+1/2*Gamma*B*Nye;
11 disp(que,"bearing capacity in lb/ft^2");
12 //part 2
13 V=0.4;
14 A=0.32;
15 g=9.81;
16 kh=0.26;
17 k=0.92; //tan(alphae)
18 Seq=0.174*k*V^2/A/g*kh^-4/A^-4;
19 disp(Seq,"settlement in m");
20 disp(Seq*39.57,"settlement in inches")

```

---

### Scilab code Exa 5.10 10

```

1 //example 5.10
2 clc; funcprot(0);

```



```

3 Cc=0.32;
4 Hc=2.5;
5 eo=0.8;
6 sigmao=2.5*16.5+0.5*(17.5-9.81)+1.25*(16-9.81);
7 m1=[2, 2, 2];
8 z=[2, 3.25, 4.5];
9 n1=[4, 6.5, 9];
10 Ic=[0.19, 0.085, 0.045];
11 Dsigma=[28.5, 12.75, 6.75]; //deltastigma
12 printf("m1\t z(m)\t n1\t Ic\t Dsigma \n");
13 for i=1:3
14     printf("%.2f\t %.2f\t %.2f\t %.2f\t %.2f\n",m1(i)
            ),z(i),n1(i),Ic(i),Dsigma(i));
15 end
16 Dsigmaav=1/6*(Dsigma(1)+4*Dsigma(2)+Dsigma(3));
17 Sc=Cc*Hc/(1+eo)*log10((sigmao+Dsigmaav)/sigmao);
18 disp(Sc*1000,"settlement in mm")
19 //partb
20 B=1;
21 L=2;
22 z=0.5+1.5;
23 B=B+z;
24 L=L+z;
25 A=0.6;
26 //from table
27 kcr=0.36;
28 Sep=kcr*Sc;
29 disp(Sep*1000,"settlement in mm");

```

---

### Scilab code Exa 5.11 11

```

1 //example 5.11
2 clc; funcprot(0);
3 N60=(3+7+12+12+16)/5;
4 B=[2, 2.25, 2.3];

```

```

5 Fd=[1.248, 1.22, 1.215];
6 Qoac=102000*9.81/1000; // actual Qo
7 Se=25;
8 printf("B(m)\t Fd\t qnet(kN/m^2)\t Qo \n");
9 for i=1:3
10     qnet(i)=10/0.08*(B(i)+0.3)^2/(B(i))^2*Fd(i)*Se
        /25;
11     Qo(i)=qnet(i)*B(i)^2;
12     printf("%.2f\t %.2f\t %.2f\t\t %.2f\n",B(i), Fd(
        i),qnet(i),Qo(i))
13 end
14 disp(Qoac,"value of Qo in kN");
15 printf("since Qo is 1000 kN thus B is equal to 2.3m
        from the table");

```

---

# Chapter 6

## Mat Foundations

Scilab code Exa 6.1 1

```
1 //example 6.1
2 clc; funcprot(0);
3 B=30;
4 L=45;
5 Df=6.5;
6 cu=1950;
7 qunet=5.14*cu*(1+0.195*B/L)*(1+0.4*Df/B);
8 disp(qunet,"allowed force in lb/ft ^2");
```

---

Scilab code Exa 6.2 2

```
1 //example 6.2
2 clc; funcprot(0);
3 N60=10;
4 Df=2;
5 B=10;
6 Se=25;
7 qnetall=N60/0.08*(1+0.33*Df/B)*Se/25;
8 disp(qnetall,"allowed pressure in kN/m ^2");
```

---

### Scilab code Exa 6.3 3

```
1 //example 6.3
2 clc; funcprot(0);
3 cu=2800;
4 B=60;
5 L=100;
6 Df=5;
7 B=60;
8 Gamma=120;
9 A=60*100;
10 Q=25e6;
11 FS=5.14*cu*(1+0.195*B/L)*(1+0.4*Df/B)/(Q/A-Gamma*Df)
12 ;
13 disp(FS,"factor of safety");
```

---

### Scilab code Exa 6.4 4

```
1 //example 6.4
2 clc; funcprot(0);
3 Cc=0.28;
4 Hc=18*12;
5 e0=0.9;
6 sigmao=11*100+40*(121.5-64)+18/2*(118-62.4);
7 H2=5+40+18;
8 H1=5+40;
9 qo=3567;
10 //from table
11 IaH2=0.21;
12 IaH1=0.225;
13 Dsigma=qo*((H2*IaH2-H1*IaH1)/(H2-H1))*4;
```

```

14 Scp=Cc*Hc/(1+e0)*log10(sigmao/sigmao+Dsigma/sigmao);
15 disp(Scp,"settlement in inches");

```

---

### Scilab code Exa 6.5 5

```

1 //example 6.5
2 clc; funcprot(0);
3 P=['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N']; //point
4 k=1.2*ones(1,14); //Q/A
5 x=[-38,-24, -12, 0, 12, 24, 38, 38, 24, 12, 0, -12, -24, -38];
6 x1=0.0017*x;
7 y=[48,48,48,48,48,48,48, -48, -48, -48, -48, -48, -48, -48];
8 y1=-0.0011*y;
9 printf("point\t Q\A (kip/ft^2)\t x(ft)\t 0.0017x(ft)\t y(ft)\t 0.0011y(ft)\t q(kip/ft^2)\n")
10 for i=1:14
11     q(i)=1.2+x1(i)+y1(i);
12     printf("%s\t %.2f\t\t %.2f\t\t%.2f\t\t %.2f\t\t %.2f\t\t %.2f\n",P(i),k(i),x(i),x1(i),y(i),y1(i),q(i))
13 end
14 printf("the soil pressure at all point is less than the given qallnet=1.5 kip/ft^2");

```

---

### Scilab code Exa 6.6 6

```

1 //example 6.6
2 clc; funcprot(0);
3 //solving for d
4 deff('y=f(d)', 'y=(96+2*d)*d-2615.1');

```

```

5 [x]=fsolve(19,f);
6 d1=x;
7 deff('y=f(d)', 'y=(96+4*d)*d-6046.4');
8 [x]=fsolve(28,f);
9 d2=x;
10 d=max(d2,d1);
11 d=round(d)
12 //now coming to design part
13 h=d+3+1;
14 disp(h,"total slab thickness in inches");
15 qa=1.082;
16 qb=1.106;
17 qm=1.212;
18 qn=1.188;
19 q1A=qa/2+qb/2;
20 disp(q1A,"force in strip ABMN in kip/ft^2");
21 q2A=qm/2+qn/2;
22 disp(q2A,"force in strip ABMN in kip/ft^2");
23 q1=1.106/3+1.127/3+1.147/3;
24 disp(q1,"force in strip BCDKLM in kip/ft^2");
25 q2=1.253/3+1.233/3+1.212/3;
26 disp(q2,"force in strip BCDKLM in kip/ft^2");
27 q1=1.147/3+1.167/3+1.188/3;
28 disp(q1,"force in strip DEFIJK in kip/ft^2");
29 q2=1.294/3+1.273/3+1.253/3;
30 disp(q2,"force in strip DEFIJK in kip/ft^2");
31 q1=1.188/2+1.212/2;
32 disp(q1,"force in strip FGHI in kip/ft^2");
33 q2=1.318/2+1.294/2;
34 disp(q2,"force in strip FGHI in kip/ft^2");
35 //checking for force
36 //net soil reaction <load
37 netforce=1/2*(1.094+1.2)*14*96+1/2*(1.127+1.233)
      *24*96+1/2*(1.167+1.273)*24*96+1/2*(1.2+1.306)
      *14*96;
38 if netforce<8761 then
39     disp("forces generated is OK")
40 end

```

```

41 //checking for reinforcement requirement
42 Q1=1.4*180+1.7*120;
43 Q2=1.4*360+1.7*200;
44 Q3=1.4*400+1.7*240;
45 Q4=1.4*180+1.7*120;
46 //solving for a
47 def f(a) = 0.9*0.51*a*60*(29-a/2) - 95.05*12;
48 [x]=fsolve(1.4,f);
49 a=x;
50 As=0.51*a
51 fy=60000;
52 disp(As,"required area in in^2");
53 Asmin=200/fy*12*29;
54 disp(Asmin,"minimum reinforcement required in^2/ft")
55 ;
56 printf("use No 9 bars at 10 inch centre to centre")

```

---

# Chapter 7

## Lateral Earth Pressure

Scilab code Exa 7.1 1

```
1 //example 7.1
2 clc; funcprot(0);
3 sigmao=48;
4 phi1=30*%pi/180;
5 phi2=36*%pi/180;
6 Ka1=(tan(%pi/4-phi1/2))^2;
7 Ka2=(tan(%pi/4-phi2/2))^2;
8 sigmaa1=Ka1*sigmao;
9 disp(sigmaa1,"top soil pressure in kN/m^2");
10 sigmaa2=Ka2*sigmao;
11 disp(sigmaa2,"bottom soil pressure in kN/m^2");
12 Po=1/2*3*16+3*12.48+1/3*3*(19.65-12.48)+1/2*3*29.43;
13 zbar=(24*(3+3/3)+37.44*(3/2)+10.76*3/3+44.1*3/3)/Po;
14 disp(zbar,"resultant force acting from the bottom in
    m");
```

---

Scilab code Exa 7.2 2



```

1 //example 7.2
2 clc; funcprot(0);
3 c=14.36;
4 Gamma=17.4;
5 H=6;
6 phi=26*%pi/180;
7 Ka=(tan(%pi/4-phi/2))^2;
8 sigma0=Gamma*H*Ka-2*c*sqrt(Ka);
9 Pa=1/2*Gamma*H^2*Ka-2*c*H*sqrt(Ka);
10 disp(Pa,"active force before which tensile crack
    appeared in kN/m");
11 zbar=(244.32-323.1)/14.46;
12 disp(zbar,"the line of action on which net force is
    acting in m");
13 zc=2*c/Gamma/sqrt(Ka);
14 disp(zc,"distance where tensile crack appeared in m"
    );
15 Pa=1/2*(H-zc)*(Gamma*H*Ka-2*c*sqrt(Ka));
16 disp(Pa,"Active force in tensile crack in kN/m");
17 zbar=(H-zc)/3;
18 disp(zbar,"the line of action on which net force is
    acting in m");

```

---

### Scilab code Exa 7.3 3

```

1 //example 7.3
2 clc; funcprot(0);
3 pi=%pi
4 H=10;
5 Gamma=110;
6 phi=35*%pi/180;
7 alpha=15*%pi/180;
8 theta=10*%pi/180;
9 zi=asin(sin(alpha)/sin(phi))-alpha+2*theta;
10 disp(zi*180/%pi,"zi in degrees");

```

```

11 Ka=cos(alpha-theta)*sqrt(1+(sin(phi))^2-2*sin(phi)*
    sin(zi))/((cos(theta))^2*(cos(alpha)+sqrt((sin(
    phi))^2+((sin(alpha))^2)))));
12 Pa=1/2*Gamma*H^2*Ka;
13 disp(Pa,"rankine earth pressure in lb/ft");
14 disp("there is slight error in answer due to
    rounding off error")
15 Beta=atan(sin(phi)*sin(zi)/(1-sin(phi)*cos(zi)));
16 disp(Beta*180/pi,"angle in degrees");

```

---

#### Scilab code Exa 7.4 4

```

1 //example 7.4
2 clc; funcprot(0);
3 H=4.6;
4 Gamma=16.5;
5 Ka=0.297;
6 Po=1/2*Gamma*H^2*Ka;
7 disp(Po,"coulomb active force per unit length in kN/
    m");

```

---

#### Scilab code Exa 7.5 5

```

1 //example 7.5
2 clc; funcprot(0);
3 //parta
4 Gamma=105;
5 H=10;
6 Kae=0.474;
7 k1=0;
8 Pae=1/2*Gamma*H^2*Kae*(1-k1)
9 disp(Pae,"active force in lb/ft");
10 //oartb

```

```

11 Ka=0.246;
12 Pa=1/2*Gamma*H^2*Ka;
13 disp(Pa," active force in lb/ft");
14 DPae=Pae-Pa; //deltaPae
15 zbar=(0.6*H*DPae+H/3*(Pa))/Pae;
16 disp(zbar,"the distance of resultant force from
    bottom in m");

```

---

### Scilab code Exa 7.6 6

```

1 //example 7.6
2 clc; funcprot(0);
3 z=[0, 4, 8, 12, 16];
4 Gamma=110;
5 phi=36*%pi/180;
6 H=16;
7 Sa1(1)=0; //sigma(1)
8 Sa2(1)=0; //sigma(2)
9 Sztr(1)=0; //sigma(z) translation
10 printf("z (ft)\t sigma(1) (lb/ft ^2)   sigma(2) (lb/ft ^2)
    sigma(z) translation (lb/ft ^2)\n");
11 for i=1:5
12     Sa1(i)=Gamma*(tan(%pi/4-phi*z(i)/2/H))^2*(z(i)-
        phi*z(i)^2/H/cos(phi*z(i)/H));
13     Sa2(i)=Gamma*z(i)*(cos(phi)/(1+sin(phi)))^2;
14     Sztr(i)=Sa1(i)/2+Sa2(i)/2;
15     printf("%.2f\t %.2f\t\t\t %.2f\t\t\t %.2f\n", z(
        i),Sa1(i),Sa2(i),Sztr(i));
16 end
17 plot(z,Sztr);
18 xtitle("sigma(z) translation vs z","z(m)","sigma(z)
    translation (lb/ft ^2)")

```

---

### Scilab code Exa 7.7 7

```
1 //example 7.7
2 Gammasat=18.86;
3 Gammaw=9.81;
4 clc; funcprot(0);
5 phi1=%pi/180*30;
6 phi2=%pi/180*26;
7 Kp1=(tan(%pi/4+phi1/2))^2;
8 Kp2=(tan(%pi/4+phi2/2))^2;
9 //for top soil
10 c=0;
11 sigma0=31.44;
12 sigmap=sigma0*Kp1+2*c*sqrt(Kp1);
13 disp(sigmap,"passive pressure for top layer in kN/m
    ^2");
14 //for z=2
15 c=10;
16 sigma0=31.44;
17 sigmap=sigma0*Kp2+2*c*sqrt(Kp2);
18 disp(sigmap,"passive pressure for z=2m in kN/m^2");
19 //for z=3
20 c=10;
21 sigma0=15.72*2+(Gammasat-Gammaw)*1;
22 sigmap=sigma0*Kp2+2*c*sqrt(Kp2);
23 disp(sigmap,"passive pressure for z=3m in kN/m^2");
```

---

# Chapter 8

## Retaining Walls

Scilab code Exa 8.1 1

```
1 //example 8.1
2 clc; funcprot(0);
3 H1=6*tan(10*%pi/180);
4 H2=18;
5 H3=2.75;
6 Gamma1=117;
7 Ka=0.294; //from table
8 H=H1+H2+H3;
9 Pa=1/2*Gamma1*H^2*Ka/1000;
10 Pr=Pa*sin(10*%pi/180);
11 Ph=Pa*cos(10*%pi/180);
12 Mo=Ph*H/3;
13 Sum=0; //sigma Mr
14 S=[1, 2, 3, 4, 5]; //section
15 W=[4.05, 1.35, 5.156, 13.01, 1.42]; //weight
16 MA=[5.75, 4.67, 6.25, 9.5, 12.5, 12.5]; //Moment Arm
17 printf("Section Weight(kip/ft) Moment Arm(ft) Moment
        (kip-ft/ft)\n");
18 for i=1:5
19     M(i)=W(i)*MA(i);
20     Sum=Sum+M(i);
```

```

21     printf("%.2f\t\t %.2f\t\t %.2f\t %.2f\n",S(i),W(
        i),MA(i),M(i));
22 end
23 FSO=Sum/Mo;
24 if FSO>2 then
25     printf("safe in overturning with FS=%.2f\n",FSO)
26 end
27 //for sliding
28 phi2=18*%pi/180;
29 V=24.986;
30 B=12.5;
31 c2=0.9;
32 FSS=(V*tan(2/3*phi2)+B*2/3*c2)/Ph;
33 if FSS>2 then
34     printf("safe in sliding with FS=%.2f\n",FSS)
35 end
36 //for bearing
37 e=B/2-(Sum-Mo)/V;
38 qtoe=V/B*(1+6*e/B);
39 Nc=13.1;
40 Nq=5.26;
41 Ny=4.07;
42 D=0.107;
43 Gamma2=4;
44 B1=B-2*e;//Bdash
45 q=Gamma2*D
46 Fcd=1+0.4*D/B1;
47 Fqd=1+2*tan(phi2)*(1-sin(phi2))^2*(D/B1);
48 Fyd=1;
49 zi=atan(Ph/V);
50 Fci=(1-zi/%pi*2)^2;
51 Fqi=Fci;
52 Fyi=round((1-zi/phi2)^2);
53 qu=c2*Nc*Fcd*Fci+q*Nq*Fqd*Fqi+1/2*Gamma2*B1*Fyd*Fyi;
54 FSB=qu/qtoe;
55 if FSB>3 then
56     printf("safe in bearing with FS=%.2f\n\n",FSB)
57 end

```

58 `disp(" slight changes due to round off error")`

---

### Scilab code Exa 8.2 2

```
1 //example 8.2
2 clc; funcprot(0);
3 c=0.9;
4 B=12.5;
5 Gamma2=4;
6 Fcd=1.138;
7 Fqd=1.107;
8 Nc=7.5;
9 Nq=4;
10 Ny=0;
11 q=0.428;
12 qtoe=2.44;
13 qu=c*Nc*Fcd+q*Nq*Fqd+1/2*Gamma2*B*Ny;
14 FSB=qu/qtoe;
15 if FSB>3 then
16     printf(" safe in bearing with FS=%.2 f\n\n",FSB)
17 end
```

---

### Scilab code Exa 8.3 3

```
1 //example 8.3
2 clc; funcprot(0);
3 Msum=0; //sum of moment
4 Vsum=0; //sum of force
5 H=15+2.5; //Hdash
6 phi=30*%pi/180;
7 Gamma=121;
8 Ka=(tan(%pi/4-phi/2))^2;
9 Pa=1/2*Gamma*H^2*Ka/1000;
```

```

10 Ph=Pa;
11 Mo=Ph*H/3;
12 AN=[1,2,3,4,5,6]; //area number
13 W=[0.9,3.375,5.906,3.863,4.764,2.723]; //weight
14 MA=[1.783,2.8,5.3,5.15,7.05,9.55]; //moment arm
15
16 printf("AreaNo Weight(kip/ft) Moment Arm(ft) Moment
(kip-ft/ft)\n");
17 for i=1:6
18     M(i)=W(i)*MA(i);
19     Vsum=Vsum+W(i);
20     Msum=Msum+M(i);
21     printf("%.2f\t\t %.2f\t\t %.2f\t %.2f\n",AN(i),W
(i),MA(i),M(i));
22 end
23 FSO=Msum/Mo;
24 if FSO>2 then
25     printf("safe in overturning with FS=%.2f\n",FSO)
26 end
27 //for sliding
28 phi2=20*pi/180;
29 V=Vsum
30 B=10.3;
31 c2=1.0;
32 FSS=(V*tan(2/3*phi2)+B*2/3*c2)/Ph;
33 printf("safe in sliding with FS=%.2f\n",FSS)
34 e=B/2-(Msum-Mo)/V;
35 qtoe=V/B*(1+6*e/B);
36 disp(qtoe,"soil pressure at toe in kip/ft^2")
37 qheel=V/B*(1-6*e/B);
38 disp(qheel,"soil pressure at heel in kip/ft^2")

```

---

#### Scilab code Exa 8.4 4

```
1 //example 8.4
```



```

2  clc; funcprot(0);
3  Msum=0; //sum of moment
4  Vsum=0; //sum of force
5  H=5+1.5; //Hdash
6  phi=32*%pi/180;
7  Gamma=18.5;
8  Ka=0.424;
9  Pa=1/2*Gamma*H^2*Ka;
10 Ph=Pa*cos(15*%pi/180+2/3*phi);
11 Mo=Ph*H/3;
12 AN=[1,2,3,4,5]; //area number
13 A=[4.36, 3.42, 0.77, 2.8, 2.8]; //area
14 W=[102.81, 80.64, 18.16, 66.02, 93.14]; //weight
15 MA=[2.18, 1.37, 0.98, 1.75, 2.83]; //moment arm
16 printf("AreaNo Area(m^2) Weight(kN/m) Momwnt Arm(m)
        Moment (kN-m/m)\n");
17 for i=1:5
18     M(i)=W(i)*MA(i);
19     Vsum=Vsum+W(i);
20     Msum=Msum+M(i);
21     printf("%.2f\t\t %.2f\t\t %.2f\t\t %.2f\t\t %.2f\n",
        AN(i),A(i),W(i),MA(i),M(i));
22 end
23 FSO=Msum/Mo;
24 if FSO>2 then
25     printf("safe in overturning with FS=%.2f\n",FSO)
26 end
27 //for sliding
28 phi2=24*%pi/180;
29 V=Vsum
30 B=3.5;
31 c2=30;
32 Pp=1/2*2.37*18*1.5^2+2*30*1.54*1.5;
33 FSS=(V*tan(2/3*phi2)+B*2/3*c2+Pp)/Ph;
34 printf("safe in sliding with FS=%.2f\n",FSS)
35 disp("if Pp is ignored then FS=1.37");
36 e=B/2-(Msum-Mo)/V;
37 qtoe=V/B*(1+6*e/B);

```

```

38 disp(qtoe,"soil pressure at toe in kN/m^2")
39 qheel=V/B*(1-6*e/B);
40 disp(qheel,"soil pressure at heel in kN/m^2")
41 disp("there is difference in answer due to rounding
      off error")

```

---

### Scilab code Exa 8.5 5

```

1 //example 8.5
2 clc; funcprot(0);
3 //from graph
4 D15=0.04;
5 D50=0.13;
6 D85=0.25;
7 printf("grain size from grain size distribution
      D15B in mm =%.2f, D85B in mm = %.2f, D50B in mm =
      %.2f\n",D15,D85,D50);

```

---

### Scilab code Exa 8.6 6

```

1 //example 8.6
2 clc; funcprot(0);
3 Sv=2;
4 Sh=3;
5 w=3/12;
6 fy=35000*144;
7 FSb=3;
8 pi=%pi;
9 phi=36*pi/180;
10 Gamma1=105;
11 H=30;
12 t=Gamma1*H*Sv*Sh*FSb/w/fy*(tan(pi/4-phi/2))^2;
13 t=t*12;

```

```

14 disp(t,"thickness in inches");
15 t=t+0.001*50;
16 disp("so take thickness=0.2 inches");
17 //for tie length
18 z=[5,10,15,20,25,30];
19 TL=[38.45, 35.89, 33.34, 30.79, 28.25, 25.7]; //tie
    length
20 printf("z(ft)\t Tie Length (ft)\n");
21 for i=1:6
22     printf("%.2f\t %.2f\n", z(i),TL(i))
23 end
24 disp("use tie length=40ft")
25 //check for over turning
26
27 z=30/3;
28 x1=20;
29 L=40;
30 Ka=0.26;
31 Pa=1/2*Gamma1*Ka*H^2;
32 W1=Gamma1*H*L;
33 FSO=W1*x1/(Pa*z);
34 disp(FSO,"factor of safety is");
35 disp("since FS>3 structure is safe")
36 //check for sliding
37 k=2/3;
38 Pa=12285;
39 FSS=W1*tan(k*phi)/Pa;
40 if FSS>3 then
41     printf("safe in sliding with FS=%.2f\n",FSS)
42 end
43 //check for bearing
44 Mr=126000*20;
45 Mo=12285*10;
46 V=126000;
47 e=L/2-Mr/V+Mo/V;
48 L1=L-2*e; //Ldash
49 c2=1000;
50 Nc=25.8;

```

```

51 Gamma2=110;
52 Ny=16.72;
53 qult=c2*Nc+1/2*Gamma2*L1*Ny
54 sigma0=Gamma1*H;
55 FSB=qult/sigma0;
56 if FSB>5 then
57     printf("safe in bearing with FS=%.2f\n\n",FSB)
58 end

```

---

### Scilab code Exa 8.7 7

```

1 //example 8.7
2 clc; funcprot(0);
3 pi=%pi;
4 phi=36*pi/180;
5 Ka=(tan(pi/4-phi/2))^2;
6 z=[8, 12, 16];
7 sigmaG=80*12;
8 Gamma1=110;
9 FS=1.5;
10 for i=1:3
11     Sv(i)=sigmaG/Gamma1/z(i)/Ka/FS*12;
12     printf("for z=%.2f ft Sv = %.2f inches\n",z(i),
13           Sv(i));
13 end
14 z=[16,56,76,96,112,144,176];
15 zf=z/12;//z in ft
16 Sv=[1.67,1.67,1.67,1.67,1.33,1.33,1.33];
17 k=[7.48,5.78,4.93,4.08,3.4,2.04,0.68];//0.51(H-z)
18 printf("z(in)    z(ft)  Sv(ft)  0.51(H-z)(ft)  0.438
19           Sv(ft)  L(ft)  \n")
19 for i=1:7
20     k2(i)=0.438*Sv(i);//0.438Sv
21     L(i)=k(i)+k2(i);
22     printf("%.2f\t %.2f\t %.2f\t %.2f\t\t %.2f\t  %

```

```
        .2 f\n",z(i),zf(i),Sv(i),k(i),k2(i),L(i));  
23 end  
24 Sv=20/12;  
25 Ka=0.26;  
26 FS=1.5;  
27 l1=Sv*Ka*FS/4/tan(2/3*phi);  
28 if l1<3 then  
29     l1=3;  
30     disp(l1,"length in ft")  
31 end
```

---

# Chapter 9

## Sheet Pile Piles

Scilab code Exa 9.1 1

```
1 //example 9.1
2 clc; funcprot(0);
3 sall=30;//sigma allowed
4 pi=%pi;
5 zbar=12.1;
6 L1=10;
7 L2=20;
8 Gamma=0.12;
9 Gamma1=0.1294-0.0624;
10 phi=40*pi/180;
11 Ka=(tan(pi/4-phi/2))^2;
12 Kp=(tan(pi/4+phi/2))^2;
13 s1=Gamma*L1*Ka;//sigma1
14 s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
15 L3=s2/(Gamma1*(Kp-Ka));
16 disp(L3,"length in ft");
17 P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2+1/2*s2*L3;
18 disp(P,"force in kip/ft");
19 s5=Gamma*L1*Kp+Gamma1*L2*Kp+Gamma*L3*(Kp-Ka);//
    sigma5
20 disp(s5,"pressure in kip/ft");
```

```

21 A1=s5/(Gamma1*(Kp-Ka));
22 A2=8*P/(Gamma1*(Kp-Ka))
23 A3=6*P*(2*zbar*(Gamma1*(Kp-Ka))+s5)/(Gamma1*(Kp-Ka))
    ^2
24 A4=P*(6*zbar*s5+4*P)/(Gamma1*(Kp-Ka))^2
25 printf("A1,A2,A3,A4 respectively in %.2f,%.2f,%.2f,%.2f\n",A1,A2,A3,A4);
26 disp("slight error due to rounding off error")
27 //partb
28 deff('y=f(x)', 'y=x^4+41.7*x^3-270.5*x^2-13363*x
    -106863');
29 [x]=fsolve(20,f);
30 D=1.88+x;
31 disp(D,"value of D, ft")
32 TL=L1+L2+1.3*D;
33 disp(TL,"total length in ft");
34 //partc
35 z=sqrt(2*P/(Gamma1*(Kp-Ka)));//zdash
36 Mmax=P*(z+zbar)-1/2*(Gamma1*(Kp-Ka))*z^2*z/3;
37 S=Mmax*12/sall;
38 disp(S,"section modulus in in^3/ft")

```

---

### Scilab code Exa 9.2 2

```

1 //example 9.2
2 clc; funcprot(0);
3 sall=172.5*1000;//sigma allowed
4 pi=%pi;
5 c=47;
6 zbar=1.78;
7 L1=2;
8 L2=3;
9 Gamma=15.9;
10 Gamma1=19.33-9.81;
11 phi=32*pi/180;

```

```

12 Ka=(tan(pi/4-phi/2))^2;
13 Kp=(tan(pi/4+phi/2))^2;
14 s1=Gamma*L1*Ka;//sigma1
15 s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
16 P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2;
17 disp(P,"force in kN/ft");
18 deff('y=f(x)', 'y=127.4*x^2-104.4*x-357.15');
19 [x]=fsolve(2,f);
20 D=x;
21 disp(D,"value of D, m")
22 disp(D*1.5,"actual D in m")
23 L4=D*(4*c-(Gamma*L1+Gamma1*L2)-P/D)/4/c;
24 disp(L4,"length in m");
25 s6=4*c-(Gamma*L1+Gamma1*L2);//sigma6
26 s7=4*c+(Gamma*L1+Gamma1*L2);//sigma7
27 z=P/s6;//zdash
28 Mmax=P*(z+zbar)-1/2*s6*z^2;
29 S=Mmax*12/sall;
30 disp(S,"section modulus in m^3/m")
31 disp("slight error due to rounding off error")

```

---

### Scilab code Exa 9.3 3

```

1 //example 9.3
2 clc; funcprot(0);
3 pi=%pi;
4 zbar=2.23;
5 L1=2;
6 L2=3;
7 Gamma=15.9;
8 Gamma1=19.33-9.81;
9 phi=32*pi/180;
10 Ka=(tan(pi/4-phi/2))^2;
11 Kp=(tan(pi/4+phi/2))^2;
12 s1=Gamma*L1*Ka;//sigma1

```



```

13 s2=Gamma*L1*Ka+Gamma1*L2*Ka; //sigma2
14 L3=s2/(Gamma1*(Kp-Ka));
15 disp(L3,"length in m");
16 P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2+1/2*s2*L3;
17 disp(P,"force in kN/m");
18 deff('y=f(x)', 'y=x^3+6.99*x^2-14.55');
19 [x]=fsolve(1.4,f);
20 D=L3+x;
21 disp(D,"value of D in m")
22 AL=1.4*D;
23 disp(AL,"actual length in m");
24 //partb
25 L4=1.4;
26 F=P-1/2*(Gamma1*(Kp-Ka)*L4^2);
27 disp(F,"anchor force in kN/m");
28 //partc
29 deff('y=f(x)', 'y=x^2+6.682*x-14.44');
30 [x]=fsolve(1.7,f);
31 z=x+2;
32 Mmax=-1/2*s1*L1*(x+2/3)+F*(x+1)-s1*x*x/2-1/2*Ka*
      Gamma1*x^3/3;
33 disp(Mmax,"maximum moment in kN-m/m")

```

---

#### Scilab code Exa 9.4 4

```

1 //example 9.4
2 clc; funcprot(0);
3 Gamma=15.9;
4 Gamma1=19.33-9.81;
5 GD=0.23;
6 CDL1=1.172;
7 L1=2;
8 L2=3;
9 Dth=(L1+L2)*GD*CDL1;
10 disp(Dth,"theoretical depth in m");

```

```

11 Dac=1.4*Dth;
12 disp(Dac," actual depth in m");
13 printf(" approximate it as 2 m");
14 //partb
15 CFL1=1.073;
16 GF=0.07;
17 Gammaa=(Gamma*L1^2+Gamma1*L2^2+2*Gamma*L1*L2)/(L1+L2
    )^2;
18 F=Gammaa*(L1+L2)^2*GF*CFL1;
19 disp(F," force in kN/m");
20 //partc
21 GM=0.021;
22 CML1=1.036;
23 Mmax=Gammaa*(L1+L2)^3*GM*CML1;
24 disp(Mmax," maximum moment in kN-m/m");

```

---

### Scilab code Exa 9.5 5

```

1 //example 9.5
2 clc; funcprot(0);
3 Mmax=43.72;
4 sp=["PSA-31","PSA-23"]; //sheet pile
5 H=[7.9,7.9]
6 I=[4.41e-6,5.63e-6];
7 p=[0.00466,0.00365];
8 S=[10.8e-5,12.8e-5];
9 Md=[18.63,22.08];
10 printf(" SheetPile      I (m^4/m)  H(m)  p\t      Logp  S
    (m^3/m)  Md(kN-m/m) Md/Mmax \n")
11 for i=1:2
12     Logp(i)=log10(p(i));
13     k(i)=Md(i)/Mmax;
14     printf("%s\t  %.2e      %.2f %f %.2f %.2e   %.2f\
    t %.3f\n",sp(i),I(i),H(i),p(i),Logp(i),S(i),
    Md(i),k(i));

```

```

15
16 end
17 plot(Logp,k);
18 xtitle("", "LogP", "Md/Mmax");

```

---

### Scilab code Exa 9.6 6

```

1 //example 9.6
2 clc; funcprot(0);
3 pi=%pi;
4 R=0.6;
5 L1=10;
6 L2=20;
7 Gammasat=122.4;
8 l1=5;
9 Gamma=110;
10 C=0.68;
11 L=L1+L2;;
12 Gammaw=62.4;
13 Gamma1=Gammasat-Gammaw; //gammadash
14 Gammaav=(Gamma*L1+Gamma1*L2)/(L1+L2);
15 phi=35*pi/180;
16 Ka=(tan(pi/4-phi/2))^2;
17 sa=C*Ka*Gammaav*L; //sigmaa
18 sp=R*sa; //sigmap
19 deff('y=f(x)', 'y=x^2+50*x-1000');
20 [x]=fsolve(15,f);
21 D=x;
22 disp(D,"depth in ft");
23 R=L/D*(L-2*l1)/(2*L+D-2*l1);
24 printf("value of R=%0.2f is OK\n",R);
25 //partb
26 F=sa*(L-R*D);
27 disp(F,"Force in lb/ft")
28 //partc

```

```

29 Mmax=0.5*sa*L^2*((1-R*D/L)^2-2*l1/L*(1-R*D/L));
30 disp(Mmax,"maximum moment lb-ft/ft");

```

---

### Scilab code Exa 9.7 7

```

1 //example 9.7
2 clc; funcprot(0);
3 pi=%pi;
4 zbar=3.2;
5 c=41;
6 L1=3;
7 L2=6;
8 Gamma=17;
9 Gamma1=20-9.81;
10 phi=35*pi/180;
11 Ka=(tan(pi/4-phi/2))^2;
12 Kp=(tan(pi/4+phi/2))^2;
13 s1=Gamma*L1*Ka;//sigma1
14 s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
15 P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2;
16 disp(P,"Force in kN/m");
17 s6=4*c-(Gamma*L1+Gamma1*L2);//sigma6
18 disp(s6,"pressure in kN/m^2");
19 deff('y=f(x)', 'y=x^2+15*x-25.43');
20 [x]=fsolve(1.6,f);
21 D=x;
22 disp(D,"depth in m");
23 F=P-s6*D;
24 disp(F,"force in kN/m");
25 printf("slight error due to rounding off")

```

---

### Scilab code Exa 9.8 4

```

1 //example 9.8
2 clc; funcprot(0);
3 pi=%pi;
4 Gamma=105;
5 Cov=14;
6 B=15/12;
7 Ka=0.26;
8 phi=35*pi/180;
9 H=37.5/12;
10 h=15/12;
11 t=6/12;
12 Gc=150; //gamma concrete
13 W=H*t*Gc;
14 k=4.5; //kp*cos(delta)
15 Pu=1/2*Gamma*H^2*(k-Ka*cos(phi));
16 disp(Pu,"force in lb/ft");
17 Pus=[(Cov+1)/(Cov+H/h)]*Pu;
18 disp(Pus,"force in lb/ft");
19 Be=0.227*(H+h)+B;
20 Pu=Pus*Be;
21 disp(Pu,"resistance of anchor plate i lb/ft")

```

---

# Chapter 10

## Braced Cuts

Scilab code Exa 10.1 1

```
1 //example 10.1
2 clc; funcprot(0);
3 Gamma=18;
4 H=7;
5 sigmaa=0.3*Gamma*H;
6 disp(sigmaa,"maximum pressure intensity in kN/m^2");
7 //partb
8 A=54.02;
9 B1=1/2*1.75*37.8+37.8*1.75-A;
10 B2=45.2;
11 C=54.02;
12 s=3; //spacing
13 Pa=C*s;
14 disp(Pa,"strut loads in kN");
15 Pb=(B1+B2)*s;
16 disp(Pb,"strut loads in kN")
17 Pc=C*s;
18 disp(Pc,"strut loads in kN");
19 //partc
20 Me=45.2*1.196-37.8*1.196*1.196/2; //Me=Mmax
21 Sall=170e3; //sigmaall
```

```

22 S=Me/Sa11;
23 disp(S,"section modulus in m^3/m");
24 //partd
25 Mmax=(B1+B2)*s^2/8;
26 S=Mmax/Sa11;
27 disp(S,"section modulus in m^3/m");

```

---

### Scilab code Exa 10.2 2

```

1 //example 10.2
2 clc; funcprot(0);
3 phi=32;
4 Gamma=112;
5 s=12; //spacing
6 H=27;
7 Ka=(tan(45*%pi/180-32*%pi/180/2))^2;
8 sigmaa=0.65*Gamma*Ka*H;
9 A=sigmaa*15*15/2/9;
10 B1=603.44*15-A;
11 C=sigmaa*12*12/2/9;
12 B2=sigmaa*s-C;
13 Pa=A*s/1000;
14 Pb=(B1+B2)*s/1000;
15 Pc=C*s/1000;
16 disp(Pa,"strut loads at A in kN");
17 disp(Pb,"strut loads at B in kN");
18 disp(Pc,"strut loads at C in kN");

```

---

### Scilab code Exa 10.3 3

```

1 //example 10.3
2 clc; funcprot(0);
3 //parta

```

```

4 s=12;
5 A=1/2*6*3.62;
6 C=1/2*1.81*3;
7 B1=1/2*2.5*1.509; //B'
8 B11=1/2*2.414*4; //B''
9 sigmaall=24;
10 Mmax=max(A,C,B1,B11);
11 S=Mmax*s/sigmaall;
12 disp(S,"section modulus in in^3/ft");
13 //partb
14
15 A=7.583;
16 Mmax=7.583*s^2/8;
17 S=Mmax*s/sigmaall;
18 disp(S,"section modulus in in^3/ft");

```

---

#### Scilab code Exa 10.4 4

```

1 //example 10.4
2 clc; funcprot(0);
3 q=0;
4 Gamma=18;
5 L=25;
6 c=35;
7 T=4;
8 H=7;
9 B1=4; //B'
10 B11=T*sqrt(2); //B''
11 FS=(5.14*c*(1+B11*0.2/L)+c*H/B1)/(Gamma*H+q)
12 disp(FS,"factor of safety is")

```

---



# Chapter 11

## Pile Foundations

Scilab code Exa 11.1 1

```
1 //example 11.1
2 clc; funcprot(0);
3 //parta
4 phi=30;
5 pa=2000;
6 q=100*50/1000;
7 Nq=55;
8 Ap=16*16/16/12;
9 Qp=Ap*q*Nq;
10 qp=0.4*pa*Nq*tan(phi*%pi/180)*Ap;
11 disp(qp,"ultimate load in lb");
12 disp(qp/1000,"ultimate load in kip");
13 disp("there is change in answer because of
      calculation mistake in the book");
14 //partb
15 Nsigma=36;
16 Ap=16*16/12/12;
17 q=110*50/1000;
18 Qp=Ap*q*Nsigma*((1+2*(1-sin(phi*%pi/180)))/3);
19 disp(Qp,"ultimate load in kip");
20 //partc
```

```
21 Nq=18.4;
22 Qp=Ap*q*Nq;
23 disp(Qp,"ultimate load in kip");
```

---

### Scilab code Exa 11.2 2

```
1 //example 11.2
2 clc; funcprot(0);
3 //parta
4 K=1.3;
5 f0=0;
6 Delta=0.8*30;
7 D=16/12;
8 L1=50;
9 p=4*16/12;
10 Gamma=110/1000;
11 L=15*D;
12 sigma=Gamma*L;
13 f20=K*sigma*tan(Delta*%pi/180);
14 Qs=(f0+f20)/2*(p*L)+f20*p*(L1-L);
15 disp(Qs,"ultimate load in kip");
16 //partb
17 FS=4;
18 Qp=56.45/3+234.7/3+179.9/3;
19 Qu=Qs+Qp;
20 Qall=Qu/FS;
21 disp(Qall,"allowed load in kip");
```

---

### Scilab code Exa 11.3 3

```
1 //example 11.3
2 clc; funcprot(0);
3 K=0.25;
```

```

4 Ap=16*16/12/12;
5 phi=30*%pi/180;
6 Nq=25;
7 q=110*50/1000;
8 sigmao=q/2;
9 p=4*16/12;
10 L=50;
11 FS=4;
12 Qu=q*Nq*Ap+K*sigmao*tan(0.8*phi)*p*L;
13 Qall=Qu/FS;
14 disp(Qall,"allowed load in kip");

```

---

#### Scilab code Exa 11.4 4

```

1 //example 11.4
2 clc; funcprot(0);
3 FS=4;
4 Ap=0.1295;
5 Nc=9;
6 cu2=100;
7 Qp=Ap*Nc*cu2;
8 D=[5, 10, 30];
9 avgD=[2.5, 7.5, 20];
10 sigma=[45, 110.5, 228.5];
11 cu=[30, 30, 100];
12 alpha=[0.6 0.9 0.725];
13 L=[5, 5, 20];
14 p=%pi*0.406;
15 Qs=0;
16 disp(Qp,"bearing capacity in kN");
17 printf("depth (m)\t avg Depth(m)\t avgVerticalStress\n"
        (kN/m^2)\t cu(kN/m^2)\t cu/sigma\t alpha\n" )
18 for i=1:3
19     cusig(i)=cu(i)/sigma(i);
20     Qs=Qs+alpha(i)*cu(i)*L(i)*p;

```



```

12     Qs=Q(i)+Qs;
13     printf("%.2f\t\t\t %.2f\t\t %.2f\t\t %.2f\t\t\t %
           .2f\n",D(i),fc(i),alpha(i),dL(i),Q(i));
14 end
15 disp(Qs,"bearing force in kN");

```

---

### Scilab code Exa 11.6 6

```

1 //example 11.6
2 clc; funcprot(0);
3 L=21;
4 Qwp=502-350;
5 Qws=350;
6 Ap=0.1045;
7 Ep=21e6;
8 epsilon=0.62;
9 Se1=(Qwp+epsilon*Qws)*L/Ap/Ep;
10 //part2
11 Iwp=0.85;
12 qwp=152/Ap;
13 Es=25e3;
14 D=0.356;
15 mus=0.35;
16 Se2=qwp*D/Es*Iwp*(1-mus^2);
17 //part3
18 p=1.168;
19 Iws=2+0.35*sqrt(L/D);
20 Se3=Qws/p/L*D/Es*Iws*(1-mus^2);
21 Se=Se1+Se2+Se3;
22 disp(Se*1000,"settlement in mm");

```

---

### Scilab code Exa 11.7 7

```

1 //example 11.7
2 clc; funcprot(0);
3 Ep=207e6;
4 Ip=123e-6;
5 nh=12000;
6 //from table
7 xz=0.008;
8 Ax=2.435;
9 T=(Ep*Ip/nh)^0.2;
10 Qg1=xz*Ep*Ip/Ax/T^3;
11 //part2
12 Fy=248000;
13 d1=0.254;
14 Am=0.772;
15 Mzmax=Fy*Ip*2/d1;
16 Qg2=Mzmax/Am/T;
17 if Qg2>Qg1 then
18     Qg=Qg1;
19     disp(Qg,"lateral load in kN");
20 end

```

---

#### Scilab code Exa 11.8 8

```

1 //example 11.8
2 clc; funcprot(0);
3 //part1
4 Ep=207e6;
5 Ip=123e-6;
6 nh=12000;
7 //from table
8 xo=0.008;
9 L=25;
10 Fy=248000;
11 D=0.254;
12 Am=0.772;

```

```

13 Gamma=18;
14 phi=35;
15 Kp=(tan(%pi/4+phi*%pi/360))^2;
16 My=Fy*Ip*2/D;
17 Qug=140*Kp*D^3*Gamma;
18
19 //part2
20 Qg1=xo*(Ep*Ip)^0.6*nh^0.4/0.15/L;
21
22 if Qug>Qg1 then
23     Qg=Qg1;
24     disp(Qg,"lateral load in kN");
25 end

```

---

#### Scilab code Exa 11.9 9

```

1 //example 11.9
2 clc; funcprot(0);
3 Wrh=30*12;
4 E=0.8;
5 Wr=7.5;
6 S=1/8;
7 C=0.1;
8 FS=6;
9 n=0.4;
10 Wp=12/12*12/12*80*150+550;
11 Wp=Wp/1000;
12 Qu=E*Wrh/(S+C)*(Wr+n^2*Wp)/(Wr+Wp);
13 Qall=Qu/FS;
14 disp(Qall,"allowed bearing capacity in kip")
15 //part2
16 He=30*12;
17 L=80*12;
18 Ap=12*12;
19 Ep=3e6/1000;

```

```

20 FS=4;
21 Qu=E*He/(S+sqrt(E*He*L/2/Ap/Ep));
22 Qall2=Qu/FS;
23 disp(Qall2,"allowed bearing capacity in kip")
24
25 //partc
26 a=27;
27 b=1;
28 He=30;
29 FS=3;
30 Qu=a*sqrt(E*He)*(b-log10(S));
31 Qall3=Qu/FS;
32 disp(Qall3,"allowed bearing capacity in kip")

```

---

#### Scilab code Exa 11.10 10

```

1 //example 11.10
2 clc; funcprot(0);
3 Hp=350;
4 vp=0.0016;
5 S1=0.762e-3;
6 f=115;
7 Qu=(0.746*Hp+98*vp)/(vp+S1*f);
8 disp(Qu,"ple load capacity in kN");

```

---

#### Scilab code Exa 11.11 11

```

1 //example 11.11
2 clc; funcprot(0);
3 Lg=9.92;
4 Bg=7;
5 n1=3;
6 Nc=8.75;

```



```

7 n2=4/1000;
8 Ap=14^2/12^2;
9 cup=1775;
10 a1=0.4; //alpha1
11 p=4*14/12;
12 cu1=1050;
13 L1=15;
14 a2=0.54; //alpha2
15 cu2=1775;
16 L2=45;
17 FS=4;
18 Qu=n1*n2*(9*Ap*cup+a1*p*cu1*L1+a2*p*cu2*L2);
19 Qu2=Lg*Bg*cup*Nc+2*(Lg+Bg)*(cu1*L1+cu2*L2);
20 disp(Qu2/1000,"load in kip")
21 Qall=Qu/FS;
22 disp(Qall,"allowed load in kip");

```

---

### Scilab code Exa 11.12 12

```

1 //example 11.12
2 clc; funcprot(0);
3 z1=21/2;
4 Lg=9;
5 Bg=6;
6 Qg=500*1000;
7 Cc1=0.3;
8 Cc2=0.2;
9 Cc3=0.25;
10 H2=12;
11 H3=6;
12 H1=21;
13 e1=0.82;
14 e2=0.7;
15 e3=0.75;
16 s1=Qg/(Lg+z1)/(Bg+z1); //sigma1

```

```

17 s2=500*1000/(9+27)/(6+27); //sigma2
18 s3=500*1000/(9+36)/(6+36); //sigma3
19 ss1=6*105+(27+21/2)*(115-62.4); //sigmadash1
20 ss2=6*105+(27+21)*(115-62.4)+(120-62.4)*6; //
    sigmadash2
21 ss3=6*105+48*(115-62.4)+12*(120-62.4)+3*(122-62.4);
    //sigmadash3
22 sc1=Cc1*H1/(1+e1)*log10((ss1+s1)/ss1);
23 sc2=Cc2*H2/(1+e2)*log10((ss2+s2)/ss2);
24 sc3=Cc3*H3/(1+e3)*log10((ss3+s3)/ss3);
25 sc=sc1+sc2+sc3;
26 disp(sc*12,"total settlement in inch");

```

---

# Chapter 12

## Drift Shaft Foundations

Scilab code Exa 12.1 1

```
1 //example 12.1
2 clc; funcprot(0);
3 Ap=%pi/4*1.75^2;
4 FS=4;
5 Nq=37.75;
6 L=8;
7 Es=50000;
8 mus=0.265;
9 pu=100;
10 Db=1.75;
11 q=6*16.2+2*19.2;
12 phi=36*%pi/180;
13 Fqs=1+tan(phi);
14 Fqd=1+2*tan(phi)*(1-sin(phi))^2*atan(L/Db);
15 Ir=Es/(2*(1+mus)*q*tan(phi));
16 delta=0.005*(1-phi/20*180/%pi+25/20)*q/pu;
17 Irr=Ir/(1+Ir*delta);
18 Fqc=exp(-3.8*tan(phi)+(3.07*sin(phi)*log10(2*Irr))
          /(1+sin(phi)));
19 Qp=Ap*(q*(Nq-1)*Fqs*Fqd*Fqc);
20 Qpall=Qp/FS;
```

```
21 disp(Qpall," allowed load in kN");
22 disp("due to rounding off error there is slight
    change in answer")
```

---

### Scilab code Exa 12.2 2

```
1 //example 12.2
2 clc; funcprot(0);
3 Ap=%pi/4*1.75^2;
4 q=135.6;
5 w=0.83;
6 FS=4;
7 phi=36;
8 Nq=0.21*exp(0.17*phi);
9 Qp=Ap*q*(w*Nq-1);
10 Qpall=Qp/FS;
11 disp(Qpall," allowed load in kN");
```

---

### Scilab code Exa 12.3 3

```
1 //example 12.3
2 clc; funcprot(0);
3 Ap=%pi/4*1.5^2;
4 Db=1.5;
5 z=3;
6 p=%pi*1;
7 Li=6;
8 N60=30;
9 sigmazi=16*z;
10 Beta=2.0-0.15*z^0.75;
11 fi=Beta*sigmazi;
12 qp=57.5*N60;
13 qpr=1.27/Db*qp;
```

```

14 Qunet=qpr*Ap+fi*p*Li;
15 disp(Qunet," allowed load in kN");
16 //part b
17 k1=0.315; //from table
18 k2=12/1.5/1000*100;
19 Qunet2=qpr*Ap*k1+fi*p*Li*k2;
20 disp(Qunet2," allowed load in kN");

```

---

#### Scilab code Exa 12.4 4

```

1 //example 12.4
2 clc; funcprot(0);
3 Nc=9;
4 Ap=%pi/4*1.5^2;
5 cu=105;
6 Qpnet=Ap*cu*Nc;
7 disp(Qpnet," net ultimate bearing point capacity in
      kN");
8 //part2
9 alpha=0.4;
10 Ds=1.5;
11 p=%pi*Ds;
12 Qs=alpha*p*(50*8+105*3);
13 disp(Qs," skin resistance in kN");
14 //part3
15 FS=3;
16 Qu=Qpnet/FS+Qs/FS;
17 disp(Qu," working load in kN");

```

---

#### Scilab code Exa 12.5 5

```

1 //example 12.5
2 clc; funcprot(0);

```

```

3 cub=3000;
4 L=20+5;
5 Db=4;
6 Ap=%pi/4*Db^2;
7 alpha=0.55;
8 cu1=800;
9 L1=7;
10 L2=5.5;
11 cu2=1200;
12 p=%pi*2.5;
13 k=alpha*p*(cu1*L1+cu2*L2); //f*p*deltaLi
14 j1=6*cub*(1+0.2*L/Db);
15 j2=9*cub;
16 [qp]=min(j1,j2);
17 Qu=k/1000+qp*Ap/1000;
18 disp(Qu,"allowed load in kN");
19 //part b
20 k1=0.57; //from table
21 k2=0.89;
22 Qunet2=qp*Ap*k1+k*k2;
23 disp(Qunet2/1000,"allowed load in kN");

```

---

### Scilab code Exa 12.6 6

```

1 //example 12.6
2 clc; funcprot(0);
3 Qws=1005-250;
4 Qwp=250;
5 epsilon=0.65;
6 L=11;
7 Ds=1.5;
8 Es=14000;
9 Ap=%pi/4*1.5^2;
10 Ep=21e6;
11 Cp=0.04;

```

```

12 Db=1.5;
13 mus=0.3;
14 p=%pi*1.5;
15 Nc=9;
16 qp=105*Nc;
17 se1=(Qwp+epsilon*Qws)*L/(Ap*Ep);
18 se2=Qwp*Cp/(Db*qp);
19 Iws=2+0.35*sqrt(L/Ds);
20 se3=Qws/p/L*Ds/Es*(1-mus^2)*Iws;
21 se=se1+se2+se3;
22 disp(se*1000,"net settlement in mm");

```

---

#### Scilab code Exa 12.7 7

```

1 //example 12.7
2 clc; funcprot(0);
3 Ds=1;
4 Ep=22e6;
5 Ri=1;
6 cu=100;
7 Ip=%pi*D4/64;
8 Qc=7.34*D2*Ep*Ri*(cu/Ep/Ri)0.6;
9 disp(Qc,"bearing force in kN");
10 Mc=3.86*D3*Ep*Ri*(cu/Ep/Ri)0.6;
11 disp(Mc,"bearing moment on kNm")
12 //from figure
13 xoQM=0.0046*1;
14 xoMQ=0.0041*1;
15 xo=0.5*(xoQM+xoMQ);
16 disp(xo*1000,"net ground line deflection in mm");
17 //partb
18 Ip=0.049;
19 Qg=150;
20 Mg=200;
21 def('y=f(T)', 'y=338e-6*T3+300.6e-6*T2-0.00435');

```

```

22 [x]=fsolve(2,f);
23 T=x;
24 k=[0, 0.4, 0.6, 0.8, 1, 1.1, 1.25]; //z/T
25 Am=[0, 0.36, 0.52, 0.63, 0.75, 0.765, 0.75];
26 Bm=[1, 0.98, 0.95, 0.9, 0.845, 0.8, 0.73];
27 printf("z/T\t Am\t Bm\t Mz(kN-m)\n");
28 for i=1:7
29     Mz(i)=Am(i)*Qg*T+Bm(i)*Mg;
30     printf("%.2f\t %.2f\t %.2f\t %.2f\n",k(i),Am(i)
        ,Bm(i),Mz(i));
31 end
32 disp(1*T,"depth in m");
33 //partc
34 Mmax=400;
35 sigma=Mmax*Ds/2/Ip;
36 disp(sigma,"tensile stress in kN/m^2");
37 //partd
38 //from figure
39 k=0.85;
40 L=k*1;
41 disp(L,"length in m");

```

---

### Scilab code Exa 12.8 8

```

1 //example 12.8
2 clc; funcprot(0);
3 qu=3000;
4 Ds=3*12;
5 L=15*12;
6 FS=3;
7 Ecore=0.36e6;
8 f=min(2.5*qu^0.5,0.15*qu);
9 Qu=%pi*Ds*L*f/1000;
10 Emass=Ecore*(0.266*80-1.66);
11 Ec=17.9*Emass;

```



```
12 Ac=%pi/4*Ds^2;  
13 If=0.35;  
14 se=Qu*L/Ac/Ec+Qu*If/Ds/Emass;  
15 Qall=Qu/FS;  
16 disp(Qall," allowed load in kN");
```

---

# Chapter 13

## Foundations on Difficult Soils

Scilab code Exa 13.1 1

```
1 //example 13.1
2 clc; funcprot(0);
3 Sw=1;
4 Z=2;
5 deltaSf=0.0033*Z*Sw*1000;
6 disp(deltaSf,"free surface swell in mm");
```

---

Scilab code Exa 13.2 2

```
1 //example 13.2
2 clc; funcprot(0);
3 //from figure
4 deltaS=1/100*1/2*(0.55+0+0.55+1.2+1.2+2+2+3);
5 disp(deltaS*1000,"total swell in mm");
6 //partb
7 D=[5.2, 4.2, 3.2, 2.2, 1.2];
8 deltaS=[0, 0.00275, 0.0115, 0.0275, 0.0525];
9 printf("depth(m)\t total swell (m) \n");
```

```

10 for i=1:5
11     printf("%.2f\t          %f \n", D(i),deltaS(i)
12         );
12 end
13 plot(deltaS*1000,D);
14 xtitle("depth vs total swell", "total swell (m)", "
    depth (m)");

```

---

### Scilab code Exa 13.3 3

```

1 //example 13.3
2 clc; funcprot(0);
3 phi=12*%pi/180;
4 Ds=0.8;
5 Z=5;
6 sigmaT=450;
7 U=%pi*Ds*Z*sigmaT*tan(phi);
8 def('y=f(D)', 'y=1202-450*6.14/1.25*3.14/4*(D
    ^2-0.8^2)');
9 [x]=fsolve(1,f);
10 Db=x;
11 disp(Db, "diameter of bell in m");
12 //partb
13 D=600;
14 cu=450;
15 Nc=6.14;
16 FS=cu*Nc*%pi/4*(Db^2-Ds^2)/(U-D);
17 if FS>2 then
18     disp("the structure is compatible with safety
    measures");
19 end
20 //check bearing capacity
21 L=D+300; //dead+live load
22 Dp=L/%pi*4/Db^2; //downward pressure
23 FS=2763/Dp;

```

```
24 if FS>3 then
25     disp("the structure is safe in bearing ");
26 end
```

---

# Chapter 14

## Soil Improvement and Ground Modification

Scilab code Exa 14.1 1

```
1 //example 14.1
2 clc; funcprot(0);
3 Cc=0.28;
4 Hc=6;
5 eo=0.9;
6 Cv=0.36;
7 H=3;
8 t=9;
9 sigmao=210;
10 sigmap=115; //deltasigmap
11 Sc=Cc*Hc/(1+eo)*log10((sigmao+sigmap)/sigmao);
12 disp(Sc*1000,"primary consolidation in mm");
13 Tv=Cv*t/H^2;
14 //from table
15 k=1.8; //constant
16 sf=k*sigmap;
17 disp(sf,"deltasigmaf in kN/m^2");
```

---

### Scilab code Exa 14.2 2

```
1 //example 14.2
2 clc; funcprot(0);
3 Tv=0.36;
4 sigmap=115;
5 Uv=sqrt(4*Tv/%pi)*100;
6 disp(Uv,"Uv in %");
7 //from table
8 k=0.12; //constant
9 sf=k*sigmap;
10 disp(sf,"deltasigmaf in kN/m^2");
```

---

### Scilab code Exa 14.3 3

```
1 //example 14.3
2 clc(); funcprot(0);
3 Cc=0.31;
4 Hc=15; //ft
5 eo=1.1;
6 n=10;
7 Uv=0.09;
8 sigmao=1000;
9 deltasigma=2000; // deltasigma+delta sigmaf
10 Sc=Cc*Hc/(1+eo)*log10((sigmao+deltasigma)/sigmao);
11 disp(Sc,"primary consolidation in ft");
12 m=n^2/(n^2-1)*log(n)-(3*n^2-1)/4/n^2;
13 A=2/m;
14 Ur=(0.096-1/A*(1-exp(-A*0.096)))/0.192;
15 Uvf=1-(1-Ur)*(1-Uv);
16 Sc30=Sc*Uvf*12; //settlement after 30 days
17 disp(Sc30,"settlement after 30 days in inch");
```

