# Scilab Textbook Companion for Principles Of Foundation Engineering by B. M. Das[1]

Created by
Avik Kumar Das
Soil Mechanics
Civil Engineering
IIT Bombay
College Teacher
None
Cross-Checked by
Chaya Ravindra

June 3, 2016

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

# Book Description

**Title:** Principles Of Foundation Engineering

**Author:** B. M. Das

**Publisher:** Ceenage Lerning Usa

**Edition:** 7

**Year:** 2007

**ISBN:** 9780495668107

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

# Chapter 1

# Geotechnical Properties of Soil

**Scilab code Exa 1.1** 1

```
//example 1.1
clc(); funcprot(0);
V=0.25; // ft^3
W=30.8; //lb
Wd=28.2; // weight dried lb
Gs=2.67;
Gammaw=62.4; //lb/ft^3
Gamma=W/V;
disp(Gamma, "moist unit weight in lb/ft^3")
w=(W-Wd)/W;
disp(w*100, "moisture content in %");
Gammad=Wd/V;
disp(Gammad, "dry unit weight in lb/ft^3")
Vs=Wd/Gs/Gammaw;
Vv=V-Vs;
e=Vv/Vs;
disp(e,"void ratio");
n=e/(1+e);
disp(n,"porosity");
Vw=(W-Wd)/Gammaw;
S=Vw/Vv;
```

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

**Scilab code Exa 1.2** 2

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

**Scilab code Exa 1.3** 3

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

**Scilab code Exa 1.4** 4

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

**Scilab code Exa 1.5** 5

```
//example 1.5
clc; funcprot(0);
F200=41;
LL=31;
PI=12;
if 100-F200>50 then
    disp("soil is coarse grained")
end
//from table 1.5 and 1.6
disp("soil is SC");
```

**Scilab code Exa 1.6** 6

```
//example 1.6
clc; funcprot(0);
Gammad=14.5;
Gammasat=17.2;
Gammaw=9.81;
```

```
printf("Point \t Sigma(kN/m^2)\t u(kN/m^2)\t sigmadash=sigma-u (kN/m^2)\n");

printf(" A\t %d\t \t %d\t\t %d \n",0,0,0);
printf(" B\t%.2f\t \t%.2f\t\t %.2f \n",4*Gammad,0,4*Gammad-0);
printf(" C\t%.2f\t \t%.2f\t\t %.2f \n",4*Gammad+5*Gammasat,5*Gammaw,4*Gammad+5*Gammasat-5*Gammaw);
```

**Scilab code Exa 1.7** 7

```
//example 1.7
clc; funcprot(0);
//parta
e1=0.92;
e2=0.86;
Hc=2.8;
s2=212;//sigma2dash
s1=140;//sigma1dash
Cc=(e1-e2)/log10(s2/s1);
Sc=Cc*Hc/(1+e1)*log10(s2/s1);
disp(Sc*1000,"consolidated depth in mm");
//part b
Sct=40;
T50=0.197;
t=4.5;
Cr=T50*12.7^2/t;
U=Sct/Sc*100/1000;
H=Hc/2;
Tv=%pi/4*U^2/100^2;
t=Tv*H^2/Cr*1000^2/60/24;
disp(t,"time required in days");
```

**Scilab code Exa 1.8** 8

```
//example 1.8
clc; funcprot(0);
Cv=7.061;
tc=15*24*60;
H=2.8/2*1000;
Scmax=87.5; // consolidation
Tc=Cv*tc/H^2;
tv=31.6*24*60;
Tv=Cv*tv/H^2;
//from figure 1.28
Sct=Scmax*0.36;
disp(Sct,"consolidation in 31.6 days in mm");
```

# Chapter 2

# Natural Soil Deposits and Subsoil Exploration

**Scilab code Exa 2.1** 1

```
//example 2.1
clc; funcprot(0);
Distance=[2.5,5,7.5,10,15,20,25,30,35,40,50];
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]

//part1
distance=5.25;
time=23e-3;
v1=distance/time;
disp(v1,"speed in m/s");
//part2
distance=11;
time=13.5e-3;
v2=distance/time;
disp(v2,"speed in m/s");
//part3
distance=14.75;
time=3.5e-3;
```

```
v3=distance/time;
disp(v3,"speed in m/s");
plot(Distance,Time);
xtitle("distance vs time","Distance in m","time in s
   ");
//part4
xc=10.4;
Ta=65e-3;
Z1=1/2*sqrt((v2-v1)/(v2+v1))*xc;
disp(Z1,"thickness of layer 1 in m");
Z2=1/2*(Ta-2*Z1*sqrt(v3^2-v1^2)/v3/v1)*v3*v2/sqrt(v3
   ^2-v2^2);
disp(Z2,"thickness of layer 2 in m");
```

# Chapter 3

# Shallow Foundations

**Scilab code Exa 3.1** 1

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

**Scilab code Exa 3.2** 2

```
//example 3.2
```

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

**Scilab code Exa 3.3** 3

```
//example 3.3
clc; funcprot(0);
```

```
phi=25; //degrees
Es=620; //kN/m^2
Gamma=18;//kN/m^2
Df=0.6;
B=0.6;
L=1.2;
Fqc=0.347;
Nq=10.66;
Nc=20.72;
Ngamma=10.88;
mu=0.3;
Fyd=1;
c=48;//kN/m^2
q=Gamma*(Df+B/2);
Ir=Es/(2*(1+mu)*(c+q*tan(phi*%pi/180)));
disp(Ir,"value of Ir");
Fcc=Fqc-(1-Fqc)/(Nq*tan(phi*%pi/180));
Fcs=1+Nq/Nc*B/L;
Fqs=1+B/L*tan(phi*%pi/180);
Fys=1-0.4*B/L;
Fcd=1+0.4*Df/B;
Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B;
q1=0.6*18;
Fyc=Fqc;
qu=c*Nc*Fcs*Fcd*Fcc+q1*Nq*Fqs*Fqd*Fqc+1/2*Gamma*Ngamma*Fys*Fyd*Fyc;
disp(qu,"ultimate bearing capacity in kN/m^2");
```

**Scilab code Exa 3.4** 4

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

```
phi=35;
Df=4;
B=6;
Gamma=110;
Ngamma=48.03;
B1=6-2*0.5;
Fqi=1;
Fyi=1;
Fyd=1;
Fqs=1;
Fys=1;
Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B;
qu=q*Nq*Fqs*Fqd*Fqi+1/2*B1*Gamma*Ngamma*Fys*Fyd*Fyi;
Qult=B1*1*qu;
disp(Qult,"ultimate bearing capacity in lb/ft");
disp(Qult/2000,"ultimate bearing capacity in ton/ft");
```

**Scilab code Exa 3.5** 5

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

```
);
```

**Scilab code Exa 3.6** 6

```
//example 3.6
clc; funcprot(0);
Df=0.7;
//from table
Nq=18.4;
Ny=22.4;
q=12.6;
phi=30; //angle
L=1.5;
Fyd=1;
Gamma=18;
L1=0.85*1.5;
L2=0.21*1.5;
B=1.5;
A=1/2*(L1+L2)*B;
B1=A/L1; //B'
Fqs=1+B1/L1*tan(phi*%pi/180);
Fys=1-0.4*B1/L1;
Fqd=1+2*tan(phi*%pi/180)*(1-sin(phi*%pi/180))^2*Df/B
    ;
Qult=A*(q*Nq*Fqs*Fqd+1/2*Gamma*B1*Ny*Fys*Fyd);
disp(Qult,"ultimate load in kN");
```

**Scilab code Exa 3.7** 7

```
//example 3.7
clc; funcprot(0);
e=0.15;
B=1.5;
```

```
Fqs=1;
L=1.5;
Gamma=18;
q=0.7*18;
//from table
Nqe=18.4;
Nye=11.58;
Fys=1+(2*e/B-0.68)*(B/L)+(0.43-3/2*e/B)*(B/L)^2;
Qult=B*L*(q*Nqe*Fqs+1/2*Gamma*Nye*Fys);
disp(Qult,"ultimate load in kN");
```

**Scilab code Exa 3.8** 8

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

# Chapter 4

# Ultimate Bearing Capacity of Shallow Foundations

**Scilab code Exa 4.1** 1

```
//example 4.1
clc; funcprot(0);
FS=4;
q=110*2;
Nq=90;
Ny=50;
Gamma=110;
m1=0.34;
B=2.5;
L=2.5;
H=1.5;
phi=35;
m2=0.45;
Fqs=1-0.34*B/L;
Fys=1-0.45*B/L;
qu=q*Nq*Fqs+1/2*Gamma*Ny*Fys*B;
Qall=qu*B^2/FS;
disp(Qall,"bearing load in lb");
```

**Scilab code Exa 4.2** 2

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

**Scilab code Exa 4.3** 3

```
//example 4.3
clc; funcprot(0);
k=0;//B/L;
c2=30;
Gamma=17.5;
H=1.5;
Df=1.2;
H=1.5;
B=2.0;
Ks=2.5;
phi=40;
pi=%pi;
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;
Qu=qu*B;
disp(Qu,"bearing capacity in kN/m");
```

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

**Scilab code Exa 4.4** 4

```
//example 4.4
clc; funcprot(0);
B=1;
L=1.5;
c2=48;
ca=108;
D=1;
H=1;
Gamma=16.8;
FS=4;
qu=(1+0.2*B/L)*5.14*c2+(1+B/L)*2*ca*H/B+Gamma*D;
c1=120;
gamma1=16.8;
Df=1;
qt=(1+0.2*B/L)*5.14*c1+gamma1*Df;
disp(qt,"qt in kN/m^2");
disp("no need to calculate qt since it is not useful
    for calculation")
disp(qu/FS,"allowable shear stress in kN/m^2");
disp(qu/FS*1*1.5,"allowable load in kN");
clear()
```

**Scilab code Exa 4.5** 5

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

**Scilab code Exa 4.6** 6

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

**Scilab code Exa 4.7** 7

```
//example 4.7
clc; funcprot(0);
phi=35;
Df=1.5;
```

```
B=1.5;
Gamma=17.4;
A=%pi/4*Df^2;
m=0.25;
Ku=0.936;
Fq=1+2*(1+m*Df/B)*Df/B*Ku*tan(phi*%pi/180);
Qu=Fq*Gamma*A*Df;
disp(Qu,"bearing capacity in kN");
```

**Scilab code Exa 4.8** 8

```
//example 4.8
clc; funcprot(0);
cu=52;
B=1.5;
L=3;
k=0.107*cu+2.5;
disp(k,"Df/B of square");
A=L*B;
Beta=0.2;
Gamma=18.9;
Df=1.8;
Qu=A*(Beta*(7.56+1.44*B/L)*cu+Gamma*Df);
disp(Qu,"ultimate shear force in kN");
```

# Chapter 5

# Shallow Foundations Allowable Bearing Capacity and Settlement

**Scilab code Exa 5.1** 1

```
//example 5.1
clc; funcprot(0);
//first solution
B1=2.5;
B2=B1;
z=12.5;
L1=5;
L2=L1;
m=B1/z;
n=B2/z;
//from table of tthe values using m,n
q=2000;
I=0.0328;
deltasigma=q*4*I;
disp(deltasigma,"change in pressure in lb/ft^2");
//second solution
Ic=0.131;//from table
```

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

**Scilab code Exa 5.2** 2

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

**Scilab code Exa 5.3** 3

```
//example 5.3
clc; funcprot(0);
H=7;
Gamma=17.5;
q0=Gamma*H
disp(q0,"pressure change in kN/m^2");
//part2
//from figure
Ileftside=0.445;
Irightside=0.445;
deltasigma=q0*(Ileftside+Irightside);
disp(deltasigma,"change in stress in kN/m^2");
//partc
```

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

**Scilab code Exa 5.4** 4

```
//example 5.4
clc; funcprot(0);
zbar=5;
mus=0.3;
F1=0.641;
F2=0.031;
z1=2;
z2=1;
z3=2;
Es1=10000;
Es2=8000;
Es3=12000;
qo=150;
//from table
If=0.709;
Es=(Es1*z1+Es2*z2+Es3*z3)/zbar;
disp(Es,"modulus of elasticity in kN/m^2");
Is=F1+(2-mus)/(1-mus)*F2;
Sc=qo*(1/Es-mus^2/Es)*Is*If*2;
Scrigid=0.93*Sc;
disp(Scrigid*1000,"settelement in mm");
```

**Scilab code Exa 5.5** 5

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

**Scilab code Exa 5.6** 6

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

```
z=[24, 72, 144, 216, 312];
Iz=[0.275, 0.425, 0.417, 0.292, 0.125];
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");
for i=1:5
    k(i)=Iz(i)/Es(i)*Dz(i);
    printf("%.2f\t \t %.2f\t\t   %.2f\t\t %.2f \t\t\t\t\t   %.2f\t\t    %.4f \n ",L(i),Dz(i),Es(i),z(i),Iz(i),k(i));
    Sum=Sum+k(i);
end
Se=C1*C2*(qbar-q)*Sum;
disp(Se,"settlement in inches");
```

**Scilab code Exa 5.7** 7

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

**Scilab code Exa 5.8** 8

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

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

**Scilab code Exa 5.9** 9

```
//example 5.9
clc; funcprot(0);
Ny=23.76;
Nq=16.51;
q=3*110;
Gamma=110;
B=4;
Nqe=0.63*Nq;
Nye=0.4*Ny;
que=q*Nqe+1/2*Gamma*B*Nye;
disp(que,"bearing capacity in lb/ft^2");
//part 2
V=0.4;
A=0.32;
g=9.81;
kh=0.26;
k=0.92;//tan(alphae)
Seq=0.174*k*V^2/A/g*kh^-4/A^-4;
disp(Seq,"settelement in m");
disp(Seq*39.57,"settlement in inches")
```

**Scilab code Exa 5.10** 10

```
//example 5.10
clc; funcprot(0);
```

```
Cc=0.32;
Hc=2.5;
eo=0.8;
sigmao=2.5*16.5+0.5*(17.5-9.81)+1.25*(16-9.81);
m1=[2, 2, 2];
z=[2, 3.25, 4.5];
n1=[4, 6.5, 9];
Ic=[0.19, 0.085, 0.045];
Dsigma=[28.5, 12.75, 6.75];//deltasigma
printf("m1\t z(m)\t n1\t Ic\t Dsigma \n");
for i=1:3
    printf("%.2f\t %.2f\t %.2f\t %.2f\t %.2f\n",m1(i
       ),z(i),n1(i),Ic(i),Dsigma(i));
end
Dsigmaav=1/6*(Dsigma(1)+4*Dsigma(2)+Dsigma(3));
Sc=Cc*Hc/(1+eo)*log10((sigmao+Dsigmaav)/sigmao);
disp(Sc*1000,"settlement in mm")
//partb
B=1;
L=2;
z=0.5+1.5;
B=B+z;
L=L+z;
A=0.6;
//from table
kcr=0.36;
Sep=kcr*Sc;
disp(Sep*1000,"settlement in mm");
```

**Scilab code Exa 5.11** 11

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

```
Fd=[1.248, 1.22, 1.215];
Qoac=102000*9.81/1000;//actual Qo
Se=25;
printf("B(m)\t Fd\t qnet(kN/m^2)\t Qo \n");
for i=1:3
    qnet(i)=10/0.08*(B(i)+0.3)^2/(B(i))^2*Fd(i)*Se/25;
    Qo(i)=qnet(i)*B(i)^2;
    printf("%.2f\t %.2f\t %.2f\t\t %.2f\n",B(i), Fd(i),qnet(i),Qo(i))
end
disp(Qoac,"value of Qo in kN");
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

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

---

**Scilab code Exa 6.2** 2

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

**Scilab code Exa 6.3** 3

```
//example 6.3
clc; funcprot(0);
cu=2800;
B=60;
L=100;
Df=5;
B=60;
Gamma=120;
A=60*100;
Q=25e6;
FS=5.14*cu*(1+0.195*B/L)*(1+0.4*Df/B)/(Q/A-Gamma*Df)
    ;
disp(FS,"factor of safety");
```

**Scilab code Exa 6.4** 4

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

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

**Scilab code Exa 6.5** 5

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

**Scilab code Exa 6.6** 6

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

```
[x]=fsolve(19,f);
d1=x;
deff('y=f(d)','y=(96+4*d)*d-6046.4');
[x]=fsolve(28,f);
d2=x;
d=max(d2,d1);
d=round(d)
//now coming to design part
h=d+3+1;
disp(h,"total slab thickness in inches");
qa=1.082;
qb=1.106;
qm=1.212;
qn=1.188;
q1A=qa/2+qb/2;
disp(q1A,"force in strip ABMN in kip/ft^2");
q2A=qm/2+qn/2;
disp(q2A,"force in strip ABMN in kip/ft^2");
q1=1.106/3+1.127/3+1.147/3;
disp(q1,"force in strip BCDKLM in kip/ft^2");
q2=1.253/3+1.233/3+1.212/3;
disp(q2,"force in strip BCDKLM in kip/ft^2");
q1=1.147/3+1.167/3+1.188/3;
disp(q1,"force in strip DEFIJK in kip/ft^2");
q2=1.294/3+1.273/3+1.253/3;
disp(q2,"force in strip DEFIJK in kip/ft^2");
q1=1.188/2+1.212/2;
disp(q1,"force in strip FGHI in kip/ft^2");
q2=1.318/2+1.294/2;
disp(q2,"force in strip FGHI in kip/ft^2");
//checking for force
//net soil reaction <load
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;
if netforce<8761 then
    disp("forces generated is OK")
end
```

```
//checking for reinforcement requirement
Q1=1.4*180+1.7*120;
Q2=1.4*360+1.7*200;
Q3=1.4*400+1.7*240;
Q4=1.4*180+1.7*120;
//solving for a
deff('y=f(a)','y=0.9*0.51*a*60*(29-a/2)-95.05*12');
[x]=fsolve(1.4,f);
a=x;
As=0.51*a
fy=60000;
disp(As,"required area in in^2");
Asmin=200/fy*12*29;
disp(Asmin,"minimum reinforcement required in^2/ft");
printf("use No 9 bars at 10 inch centre to centre")
```

# Chapter 7

# Lateral Earth Pressure

**Scilab code Exa 7.1** 1

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

**Scilab code Exa 7.2** 2

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

**Scilab code Exa 7.3** 3

```
//example 7.3
clc; funcprot(0);
pi=%pi
H=10;
Gamma=110;
phi=35*%pi/180;
alpha=15*%pi/180;
theta=10*%pi/180;
zi=asin(sin(alpha)/sin(phi))-alpha+2*theta;
disp(zi*180/%pi,"zi in degrees");
```

```
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))));
Pa=1/2*Gamma*H^2*Ka;
disp(Pa,"rankine earth pressure in lb/ft");
disp("there is slight error in answer due to rounding off error")
Beta=atan(sin(phi)*sin(zi)/(1-sin(phi)*cos(zi)));
disp(Beta*180/pi,"angle in degrees");
```

**Scilab code Exa 7.4** 4

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

**Scilab code Exa 7.5** 5

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

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

**Scilab code Exa 7.6** 6

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

**Scilab code Exa 7.7** 7

```
//example 7.7
Gammasat=18.86;
Gammaw=9.81;
clc; funcprot(0);
phi1=%pi/180*30;
phi2=%pi/180*26;
Kp1=(tan(%pi/4+phi1/2))^2;
Kp2=(tan(%pi/4+phi2/2))^2;
//for top soil
c=0;
sigma0=31.44;
sigmap=sigma0*Kp1+2*c*sqrt(Kp1);
disp(sigmap,"passive pressure for top layer in kN/m
    ^2");
//for z=2
c=10;
sigma0=31.44;
sigmap=sigma0*Kp2+2*c*sqrt(Kp2);
disp(sigmap,"passive pressure for z=2m in kN/m^2");
//for z=3
c=10;
sigma0=15.72*2+(Gammasat-Gammaw)*1;
sigmap=sigma0*Kp2+2*c*sqrt(Kp2);
disp(sigmap,"passive pressure for z=3m in kN/m^2");
```

# Chapter 8

# Retaining Walls

**Scilab code Exa 8.1** 1

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

```
    printf("%.2f\t\t %.2f\t\t %.2f\t %.2f\n",S(i),W(
       i),MA(i),M(i));
end
FSO=Sum/Mo;
if FSO>2 then
    printf("safe in overturning with FS=%.2f\n",FSO)
end
//for sliding
phi2=18*%pi/180;
V=24.986;
B=12.5;
c2=0.9;
FSS=(V*tan(2/3*phi2)+B*2/3*c2)/Ph;
if FSS>2 then
    printf("safe in sliding with FS=%.2f\n",FSS)
end
//for bearing
e=B/2-(Sum-Mo)/V;
qtoe=V/B*(1+6*e/B);
Nc=13.1;
Nq=5.26;
Ny=4.07;
D=0.107;
Gamma2=4;
B1=B-2*e;//Bdash
q=Gamma2*D
Fcd=1+0.4*D/B1;
Fqd=1+2*tan(phi2)*(1-sin(phi2))^2*(D/B1);
Fyd=1;
zi=atan(Ph/V);
Fci=(1-zi/%pi*2)^2;
Fqi=Fci;
Fyi=round((1-zi/phi2)^2);
qu=c2*Nc*Fcd*Fci+q*Nq*Fqd*Fqi+1/2*Gamma2*B1*Fyd*Fyi;
FSB=qu/qtoe;
if FSB>3 then
    printf("safe in bearing with FS=%.2f\n\n",FSB)
end
```

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

**Scilab code Exa 8.2** 2

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

**Scilab code Exa 8.3** 3

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

```
Ph=Pa;
Mo=Ph*H/3;
AN=[1,2,3,4,5,6];//area number
W=[0.9,3.375,5.906,3.863,4.764,2.723];//weight
MA=[1.783,2.8,5.3,5.15,7.05,9.55];//moment arm

printf("AreaNo Weight(kip/ft) Moment Arm(ft) Moment
    (kip-ft/ft)\n");
for i=1:6
    M(i)=W(i)*MA(i);
    Vsum=Vsum+W(i);
    Msum=Msum+M(i);
    printf("%.2f\t\t %.2f\t\t %.2f\t %.2f\n",AN(i),W
       (i),MA(i),M(i));
end
FSO=Msum/Mo;
if FSO>2 then
    printf("safe in overturning with FS=%.2f\n",FSO)
end
//for sliding
phi2=20*%pi/180;
V=Vsum
B=10.3;
c2=1.0;
FSS=(V*tan(2/3*phi2)+B*2/3*c2)/Ph;
printf("safe in sliding with FS=%.2f\n",FSS)
e=B/2-(Msum-Mo)/V;
qtoe=V/B*(1+6*e/B);
disp(qtoe,"soil pressure at toe in kip/ft^2")
qheel=V/B*(1-6*e/B);
disp(qheel,"soil pressure at heel in kip/ft^2")
```

**Scilab code Exa 8.4** 4

```
//example 8.4
```

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

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

**Scilab code Exa 8.5** 5

```
//example 8.5
clc; funcprot(0);
//from graph
D15=0.04;
D50=0.13;
D85=0.25;
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

```
//example 8.6
clc; funcprot(0);
Sv=2;
Sh=3;
w=3/12;
fy=35000*144;
FSb=3;
pi=%pi;
phi=36*pi/180;
Gamma1=105;
H=30;
t=Gamma1*H*Sv*Sh*FSb/w/fy*(tan(pi/4-phi/2))^2;
t=t*12;
```

```
disp(t,"thiskness in inches");
t=t+0.001*50;
disp("so take thickness=0.2 inches");
//for tie length
z=[5,10,15,20,25,30];
TL=[38.45, 35.89, 33.34, 30.79, 28.25, 25.7];//tie
    length
printf("z(ft)\t Tie Length (ft)\n");
for i=1:6
    printf("%.2f\t %.2f\n", z(i),TL(i))
end
disp("use tie length=40ft")
//check for over turning

z=30/3;
x1=20;
L=40;
Ka=0.26;
Pa=1/2*Gamma1*Ka*H^2;
W1=Gamma1*H*L;
FSO=W1*x1/(Pa*z);
disp(FSO,"factor of safety is");
disp("since FS>3 structure is safe")
//check for sliding
k=2/3;
Pa=12285;
FSS=W1*tan(k*phi)/Pa;
if FSS>3 then
    printf("safe in sliding with FS=%.2f\n",FSS)
end
//check for bearing
Mr=126000*20;
Mo=12285*10;
V=126000;
e=L/2-Mr/V+Mo/V;
L1=L-2*e;//Ldash
c2=1000;
Nc=25.8;
```

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

**Scilab code Exa 8.7** 7

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

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

# Chapter 9

# Sheet Pile Piles

**Scilab code Exa 9.1** 1

```
//example 9.1
clc; funcprot(0);
sall=30;//sigma allowed
pi=%pi;
zbar=12.1;
L1=10;
L2=20;
Gamma=0.12;
Gamma1=0.1294-0.0624;
phi=40*pi/180;
Ka=(tan(pi/4-phi/2))^2;
Kp=(tan(pi/4+phi/2))^2;
s1=Gamma*L1*Ka;//sigma1
s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
L3=s2/(Gamma1*(Kp-Ka));
disp(L3,"length in ft");
P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2+1/2*s2*L3;
disp(P,"force in kip/ft");
s5=Gamma*L1*Kp+Gamma1*L2*Kp+Gamma*L3*(Kp-Ka);//
   sigma5
disp(s5,"pressure in kip/ft");
```

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

**Scilab code Exa 9.2** 2

```
//example 9.2
clc; funcprot(0);
sall=172.5*1000;//sigma allowed
pi=%pi;
c=47;
zbar=1.78;
L1=2;
L2=3;
Gamma=15.9;
Gamma1=19.33-9.81;
phi=32*pi/180;
```

```
Ka=(tan(pi/4-phi/2))^2;
Kp=(tan(pi/4+phi/2))^2;
s1=Gamma*L1*Ka;//sigma1
s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2;
disp(P,"force in kN/ft");
deff('y=f(x)','y=127.4*x^2-104.4*x-357.15');
[x]=fsolve(2,f);
D=x;
disp(D,"value of D, m")
disp(D*1.5,"actual D in m")
L4=D*(4*c-(Gamma*L1+Gamma1*L2)-P/D)/4/c;
disp(L4,"length in m");
s6=4*c-(Gamma*L1+Gamma1*L2);//sigma6
s7=4*c+(Gamma*L1+Gamma1*L2);//sigma7
z=P/s6;//zdash
Mmax=P*(z+zbar)-1/2*s6*z^2;
S=Mmax*12/sall;
disp(S,"section modulus in m^3/m")
disp("slight error due to rounding off error")
```

**Scilab code Exa 9.3** 3

```
//example 9.3
clc; funcprot(0);
pi=%pi;
zbar=2.23;
L1=2;
L2=3;
Gamma=15.9;
Gamma1=19.33-9.81;
phi=32*pi/180;
Ka=(tan(pi/4-phi/2))^2;
Kp=(tan(pi/4+phi/2))^2;
s1=Gamma*L1*Ka;//sigma1
```

```
s2=Gamma*L1*Ka+Gamma1*L2*Ka;//sigma2
L3=s2/(Gamma1*(Kp-Ka));
disp(L3,"length in m");
P=1/2*s1*L1+s1*L2+1/2*(s2-s1)*L2+1/2*s2*L3;
disp(P,"force in kN/m");
deff('y=f(x)','y=x^3+6.99*x^2-14.55');
[x]=fsolve(1.4,f);
D=L3+x;
disp(D,"value of D in m")
AL=1.4*D;
disp(AL,"actual length in m");
//partb
L4=1.4;
F=P-1/2*(Gamma1*(Kp-Ka)*L4^2);
disp(F,"anchor force in kN/m");
//partc
deff('y=f(x)','y=x^2+6.682*x-14.44');
[x]=fsolve(1.7,f);
z=x+2;
Mmax=-1/2*s1*L1*(x+2/3)+F*(x+1)-s1*x*x/2-1/2*Ka*
    Gamma1*x^3/3;
disp(Mmax,"maximum moment in kN-m/m")
```

**Scilab code Exa 9.4** 4

```
//example 9.4
clc; funcprot(0);
Gamma=15.9;
Gamma1=19.33-9.81;
GD=0.23;
CDL1=1.172;
L1=2;
L2=3;
Dth=(L1+L2)*GD*CDL1;
disp(Dth,"theoritical depth in m");
```

```
Dac=1.4*Dth;
disp(Dac,"actual depth in m");
printf("approximate it as 2 m");
//partb
CFL1=1.073;
GF=0.07;
Gammaa=(Gamma*L1^2+Gamma1*L2^2+2*Gamma*L1*L2)/(L1+L2)^2;
F=Gammaa*(L1+L2)^2*GF*CFL1;
disp(F,"force in kN/m");
//partc
GM=0.021;
CML1=1.036;
Mmax=Gammaa*(L1+L2)^3*GM*CML1;
disp(Mmax,"maximum moment in kN-m/m");
```

**Scilab code Exa 9.5** 5

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

```

end
plot(Logp,k);
xtitle("","LogP","Md/Mmax");
```

**Scilab code Exa 9.6** 6

```
//example 9.6
clc; funcprot(0);
pi=%pi;
R=0.6;
L1=10;
L2=20;
Gammasat=122.4;
l1=5;
Gamma=110;
C=0.68;
L=L1+L2;;
Gammaw=62.4;
Gamma1=Gammasat-Gammaw;//gammadash
Gammaav=(Gamma*L1+Gamma1*L2)/(L1+L2);
phi=35*pi/180;
Ka=(tan(pi/4-phi/2))^2;
sa=C*Ka*Gammaav*L;//sigmaa
sp=R*sa;//sigmap
deff('y=f(x)', 'y=x^2+50*x-1000');
[x]=fsolve(15,f);
D=x;
disp(D,"depth in ft");
R=L/D*(L-2*l1)/(2*L+D-2*l1);
printf("value of R=%.2f is OK\n",R);
//partb
F=sa*(L-R*D);
disp(F,"Force in lb/ft")
//partc
```

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

**Scilab code Exa 9.7** 7

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

**Scilab code Exa 9.8** 4

```
//example 9.8
clc; funcprot(0);
pi=%pi;
Gamma=105;
Cov=14;
B=15/12;
Ka=0.26;
phi=35*pi/180;
H=37.5/12;
h=15/12;
t=6/12;
Gc=150;//gamma concrete
W=H*t*Gc;
k=4.5;//kp*cos(delta)
Pu=1/2*Gamma*H^2*(k-Ka*cos(phi));
disp(Pu,"force in lb/ft");
Pus=[(Cov+1)/(Cov+H/h)]*Pu;
disp(Pus,"force in lb/ft");
Be=0.227*(H+h)+B;
Pu=Pus*Be;
disp(Pu,"resistance of anchor plate i lb/ft")
```

# Chapter 10

# Braced Cuts

**Scilab code Exa 10.1** 1

```
//example 10.1
clc; funcprot(0);
Gamma=18;
H=7;
sigmaa=0.3*Gamma*H;
disp(sigmaa,"maximum pressure intensity in kN/m^2");
//partb
A=54.02;
B1=1/2*1.75*37.8+37.8*1.75-A;
B2=45.2;
C=54.02;
s=3; //spacing
Pa=C*s;
disp(Pa,"strut loads in kN");
Pb=(B1+B2)*s;
disp(Pb,"strut loads in kN")
Pc=C*s;
disp(Pc,"strut loads in kN");
//partc
Me=45.2*1.196-37.8*1.196*1.196/2;//Me=Mmax
Sall=170e3;//sigmaall
```

```
S=Me/Sall;
disp(S,"section modulus in m^3/m");
//partd
Mmax=(B1+B2)*s^2/8;
S=Mmax/Sall;
disp(S,"section modulus in m^3/m");
```

**Scilab code Exa 10.2** 2

```
//example 10.2
clc; funcprot(0);
phi=32;
Gamma=112;
s=12;//spacing
H=27;
Ka=(tan(45*%pi/180-32*%pi/180/2))^2;
sigmaa=0.65*Gamma*Ka*H;
A=sigmaa*15*15/2/9;
B1=603.44*15-A;
C=sigmaa*12*12/2/9;
B2=sigmaa*s-C;
Pa=A*s/1000;
Pb=(B1+B2)*s/1000;
Pc=C*s/1000;
disp(Pa,"strut loads at A in kN");
disp(Pb,"strut loads at B in kN");
disp(Pc,"strut loads at C in kN");
```

**Scilab code Exa 10.3** 3

```
//example 10.3
clc; funcprot(0);
//parta
```

```
s=12;
A=1/2*6*3.62;
C=1/2*1.81*3;
B1=1/2*2.5*1.509;//B'
B11=1/2*2.414*4;//B''
sigmaall=24;
Mmax=max(A,C,B1,B11);
S=Mmax*s/sigmaall;
disp(S,"section modulus in in^3/ft");
//partb

A=7.583;
Mmax=7.583*s^2/8;
S=Mmax*s/sigmaall;
disp(S,"section modulus in in^3/ft");
```

**Scilab code Exa 10.4** 4

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

# Chapter 11

# Pile Foundations

**Scilab code Exa 11.1** 1

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

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

**Scilab code Exa 11.2** 2

```
//example 11.2
clc; funcprot(0);
//parta
K=1.3;
f0=0;
Delta=0.8*30;
D=16/12;
L1=50;
p=4*16/12;
Gamma=110/1000;
L=15*D;
sigma=Gamma*L;
f20=K*sigma*tan(Delta*%pi/180);
Qs=(f0+f20)/2*(p*L)+f20*p*(L1-L);
disp(Qs,"ultimate load in kip");
//partb
FS=4;
Qp=56.45/3+234.7/3+179.9/3;
Qu=Qs+Qp;
Qall=Qu/FS;
disp(Qall,"allowed load in kip");
```

**Scilab code Exa 11.3** 3

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

```
Ap=16*16/12/12;
phi=30*%pi/180;
Nq=25;
q=110*50/1000;
sigmao=q/2;
p=4*16/12;
L=50;
FS=4;
Qu=q*Nq*Ap+K*sigmao*tan(0.8*phi)*p*L;
Qall=Qu/FS;
disp(Qall,"allowed load in kip");
```

**Scilab code Exa 11.4** 4

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

```
    printf("%.2f\t              %.2f\t              %.2f\t\t\t    %.2f\t    %.2f\t\t %.2f\n",D(i),avgD(i),sigma(i),cu(i),cusig(i),alpha(i));
end
disp(Qs,"bearing capacity in kN");
//part2
lambda=0.136;
L=30;
fav=lambda*(178.48+2*76.7);
Qs2=p*L*fav;
//part3
fav1=13;
fav2=31.9;
fav3=93.43;
Qs3=p*(fav1*5+fav2*5+fav3*20);
disp(Qs3,"bearing capacity in kN");
Qsavg=Qs/3+Qs2/3+Qs3/3;
Qu=Qp+Qsavg
Qall=Qu/FS;
disp(Qall,"allowed bearing capacity in kN");
```

**Scilab code Exa 11.5** 5

```
//example 11.5
clc; funcprot(0);
D=[6, 12, 20];
fc=[34.34, 54.94, 70.63];
alpha=[0.84, 0.71, 0.63];
dL=[6, 6, 8];
p=4*0.305;
Qs=0;
printf("  depth(m)\t  fc(kN/m^2)\t  alpha \t  deltaL(m)\t Q(kN)\n");
for i=1:3
    Q(i)=alpha(i)*fc(i)*p*dL(i);
```

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

**Scilab code Exa 11.6** 6

```
//example 11.6
clc; funcprot(0);
L=21;
Qwp=502-350;
Qws=350;
Ap=0.1045;
Ep=21e6;
epsilon=0.62;
Se1=(Qwp+epsilon*Qws)*L/Ap/Ep;
//part2
Iwp=0.85;
qwp=152/Ap;
Es=25e3;
D=0.356;
mus=0.35;
Se2=qwp*D/Es*Iwp*(1-mus^2);
//part3
p=1.168;
Iws=2+0.35*sqrt(L/D);
Se3=Qws/p/L*D/Es*Iws*(1-mus^2);
Se=Se1+Se2+Se3;
disp(Se*1000,"settlement in mm");
```

**Scilab code Exa 11.7** 7

```
//example 11.7
clc; funcprot(0);
Ep=207e6;
Ip=123e-6;
nh=12000;
//from table
xz=0.008;
Ax=2.435;
T=(Ep*Ip/nh)^0.2;
Qg1=xz*Ep*Ip/Ax/T^3;
//part2
Fy=248000;
d1=0.254;
Am=0.772;
Mzmax=Fy*Ip*2/d1;
Qg2=Mzmax/Am/T;
if Qg2>Qg1 then
    Qg=Qg1;
    disp(Qg,"lateral load in kN");
end
```

**Scilab code Exa 11.8** 8

```
//example 11.8
clc; funcprot(0);
//part1
Ep=207e6;
Ip=123e-6;
nh=12000;
//from table
xo=0.008;
L=25;
Fy=248000;
D=0.254;
Am=0.772;
```

```
Gamma=18;
phi=35;
Kp=(tan(%pi/4+phi*%pi/360))^2;
My=Fy*Ip*2/D;
Qug=140*Kp*D^3*Gamma;

//part2
Qg1=xo*(Ep*Ip)^0.6*nh^0.4/0.15/L;

if Qug>Qg1 then
    Qg=Qg1;
    disp(Qg,"lateral load in kN");
end
```

**Scilab code Exa 11.9** 9

```
//example 11.9
clc; funcprot(0);
Wrh=30*12;
E=0.8;
Wr=7.5;
S=1/8;
C=0.1;
FS=6;
n=0.4;
Wp=12/12*12/12*80*150+550;
Wp=Wp/1000;
Qu=E*Wrh/(S+C)*(Wr+n^2*Wp)/(Wr+Wp);
Qall=Qu/FS;
disp(Qall,"allowed bearing capacity in kip")
//part2
He=30*12;
L=80*12;
Ap=12*12;
Ep=3e6/1000;
```

```
FS=4;
Qu=E*He/(S+sqrt(E*He*L/2/Ap/Ep));
Qall2=Qu/FS;
disp(Qall2,"allowed bearing capacity in kip")

//partc
a=27;
b=1;
He=30;
FS=3;
Qu=a*sqrt(E*He)*(b-log10(S));
Qall3=Qu/FS;
disp(Qall3,"allowed bearing capacity in kip")
```

**Scilab code Exa 11.10** 10

```
//example 11.10
clc; funcprot(0);
Hp=350;
vp=0.0016;
Sl=0.762e-3;
f=115;
Qu=(0.746*Hp+98*vp)/(vp+Sl*f);
disp(Qu,"ple load capacity in kN");
```

**Scilab code Exa 11.11** 11

```
//example 11.11
clc; funcprot(0);
Lg=9.92;
Bg=7;
n1=3;
Nc=8.75;
```

```
n2=4/1000;
Ap=14^2/12^2;
cup=1775;
a1=0.4;//alpha1
p=4*14/12;
cu1=1050;
L1=15;
a2=0.54;//alpha2
cu2=1775;
L2=45;
FS=4;
Qu=n1*n2*(9*Ap*cup+a1*p*cu1*L1+a2*p*cu2*L2);
Qu2=Lg*Bg*cup*Nc+2*(Lg+Bg)*(cu1*L1+cu2*L2);
disp(Qu2/1000,"load in kip")
Qall=Qu/FS;
disp(Qall,"allowed load in kip");
```

**Scilab code Exa 11.12** 12

```
//example 11.12
clc; funcprot(0);
z1=21/2;
Lg=9;
Bg=6;
Qg=500*1000;
Cc1=0.3;
Cc2=0.2;
Cc3=0.25;
H2=12;
H3=6;
H1=21;
e1=0.82;
e2=0.7;
e3=0.75;
s1=Qg/(Lg+z1)/(Bg+z1); //sigma1
```

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

# Chapter 12

# Drift Shaft Foundations

**Scilab code Exa 12.1** 1

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

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

**Scilab code Exa 12.2** 2

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

**Scilab code Exa 12.3** 3

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

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

**Scilab code Exa 12.4** 4

```
//example 12.4
clc; funcprot(0);
Nc=9;
Ap=%pi/4*1.5^2;
cu=105;
Qpnet=Ap*cu*Nc;
disp(Qpnet,"net ultimate bearing point capacity in
    kN");
//part2
alpha=0.4;
Ds=1.5;
p=%pi*Ds;
Qs=alpha*p*(50*8+105*3);
disp(Qs,"skin resistance in kN");
//part3
FS=3;
Qu=Qpnet/FS+Qs/FS;
disp(Qu,"working load in kN");
```

**Scilab code Exa 12.5** 5

```
//example 12.5
clc; funcprot(0);
```

```
cub=3000;
L=20+5;
Db=4;
Ap=%pi/4*Db^2;
alpha=0.55;
cu1=800;
L1=7;
L2=5.5;
cu2=1200;
p=%pi*2.5;
k=alpha*p*(cu1*L1+cu2*L2);//f*p*deltaLi
j1=6*cub*(1+0.2*L/Db);
j2=9*cub;
[qp]=min(j1,j2);
Qu=k/1000+qp*Ap/1000;
disp(Qu,"allowed load in kN");
//part b
k1=0.57; //from table
k2=0.89;
Qunet2=qp*Ap*k1+k*k2;
disp(Qunet2/1000,"allowed load in kN");
```

**Scilab code Exa 12.6** 6

```
//example 12.6
clc; funcprot(0);
Qws=1005-250;
Qwp=250;
epsilon=0.65;
L=11;
Ds=1.5;
Es=14000;
Ap=%pi/4*1.5^2;
Ep=21e6;
Cp=0.04;
```

```
Db=1.5;
mus=0.3;
p=%pi*1.5;
Nc=9;
qp=105*Nc;
se1=(Qwp+epsilon*Qws)*L/(Ap*Ep);
se2=Qwp*Cp/(Db*qp);
Iws=2+0.35*sqrt(L/Ds);
se3=Qws/p/L*Ds/Es*(1-mus^2)*Iws;
se=se1+se2+se3;
disp(se*1000,"net settlement in mm");
```

**Scilab code Exa 12.7** 7

```
//example 12.7
clc; funcprot(0);
Ds=1;
Ep=22e6;
Ri=1;
cu=100;
Ip=%pi*Ds^4/64;
Qc=7.34*Ds^2*Ep*Ri*(cu/Ep/Ri)^0.6;
disp(Qc,"bearing force in kN");
Mc=3.86*Ds^3*Ep*Ri*(cu/Ep/Ri)^0.6;
disp(Mc,"bearing moment on kNm")
//from figure
xoQM=0.0046*1;
xoMQ=0.0041*1;
xo=0.5*(xoQM+xoMQ);
disp(xo*1000,"net ground line deflection in mm");
//partb
Ip=0.049;
Qg=150;
Mg=200;
deff('y=f(T)','y=338e-6*T^3+300.6e-6*T^2-0.00435');
```

```
[x]=fsolve(2,f);
T=x;
k=[0, 0.4, 0.6, 0.8, 1, 1.1, 1.25];//z/T
Am=[0, 0.36, 0.52, 0.63, 0.75, 0.765, 0.75];
Bm=[1, 0.98, 0.95, 0.9, 0.845, 0.8, 0.73];
printf("z/T\t Am\t Bm\t Mz(kN-m)\n");
for i=1:7
    Mz(i)=Am(i)*Qg*T+Bm(i)*Mg;
    printf("%.2f\t %.2f\t %.2f\t %.2f \n",k(i),Am(i)
       ,Bm(i),Mz(i));
end
disp(1*T,"depth in m");
//partc
Mmax=400;
sigma=Mmax*Ds/2/Ip;
disp(sigma,"tensile stress in kN/m^2");
//partd
//from figure
k=0.85;
L=k*1;
disp(L,"length in m");
```

**Scilab code Exa 12.8** 8

```
//example 12.8
clc; funcprot(0);
qu=3000;
Ds=3*12;
L=15*12;
FS=3;
Ecore=0.36e6;
f=min(2.5*qu^0.5,0.15*qu);
Qu=%pi*Ds*L*f/1000;
Emass=Ecore*(0.266*80-1.66);
Ec=17.9*Emass;
```

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

# Chapter 13

# Foundations on Difficult Soils

**Scilab code Exa 13.1** 1

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

**Scilab code Exa 13.2** 2

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

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

**Scilab code Exa 13.3** 3

```
//example 13.3
clc; funcprot(0);
phi=12*%pi/180;
Ds=0.8;
Z=5;
sigmaT=450;
U=%pi*Ds*Z*sigmaT*tan(phi);
deff('y=f(D)','y=1202-450*6.14/1.25*3.14/4*(D
   ^2-0.8^2)');
[x]=fsolve(1,f);
Db=x;
disp(Db,"diameter of bell in m");
//partb
D=600;
cu=450;
Nc=6.14;
FS=cu*Nc*%pi/4*(Db^2-Ds^2)/(U-D);
if FS>2 then
    disp("the structure is compatible with safety
        measures");
end
//check bearing capacity
L=D+300;//dead+live load
Dp=L/%pi*4/Db^2;//downward pressure
FS=2763/Dp;
```

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

# Chapter 14

# Soil Improvement and Ground Modification

**Scilab code Exa 14.1** 1

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

**Scilab code Exa 14.2** 2

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

---

**Scilab code Exa 14.3** 3

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