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

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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

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");
```