Scilab Textbook Companion for Structural And Stress Analysis by T. H. G. Megson[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 2

Principles of Statics

Scilab code Exa 2.1 chapter 2 example 1

```
1  clc
2  //initialisation of variables
3  F1= -2.0 //KN
4  F2= 3.0 //KN
5  F3= -6.0 //KN
6  F4= -1.0 //KN
7  x1= 0 //m
8  x2= 0.6 //m
9  x3= 0.9 //m
10 x4= 1.2 //m
11 //CALCULATIONS
12 R= -(F1+F2+F3+F4)
13 x= -(x1*F1+x2*F2+x3*F3+x4*F4)/R
14 //RESULTS
15 printf ('R= %.2f kN',R)
16 printf (' \n x=%.2f m',x)
```

Scilab code Exa 2.2 chapter 2 example 2

```
1  clc
2  //initialisation of variables
3  F1= 5*cosd(60) //KN
4  F2= 5*sind(60) //KN
5  F3= -3 //KN
6  x1= 1.2 //m
7  x2= 0.9 //m
8  x3= 0.4 //m
9  //CALCULATIONS
10 Rah= F1
11 Rav= (-(F3*x2)+F2*x3)/1.2
12 Rd= -F3+F2-Rav
13 //RESULTS
14 printf ('Rah= %.1f kN',Rah)
15 printf (' \n Rav=%.1f KN',Rav)
16 printf (' \n Rd=%.1f KN',Rd)
```

Scilab code Exa 2.3 chapter 2 example 3

```
1  clc
2  //initialisation of variables
3  F1= -2*cosd(45) //KN
4  F2= -2*sind(45) //KN
5  F3= -5 //KN
6  x1= 0.4 //m
7  x2= 1.0 //m
8  Rc= 2.5 //m
9  Rd= 3.7 //m
10 //CALCULATIONS
11 Rah= -F1
12 Rav= -F3-F2
13 Ma= -F3*x1-F2*x2
14 Ra= sqrt(Rc^2+Rd^2)
15 theta= atan(Rc/Rd) *180/%pi
16 //RESULTS
```

```
17  printf ('Rah= %.1f kN',Rah)
18  printf (' \n Rav=%.1f KN',Rav)
19  printf (' \n Ma=%.1f KNm',Ma)
20  printf (' \n Ra=%.1f KN',Ra)
21  printf (' \n theta=%.1f degrees',theta)
```

Scilab code Exa 2.4 chapter 2 example 4

```
1  clc
2  //initialisation of variables
3  alpha= atand(2.4/3) //degrees
4  F1= 5*sind(alpha) //KN
5  F2= 10*sind(alpha) //KN
6  F3= 3 //KN
7  F4= 2 //KN
8  F5= -5*cosd(alpha) //KN
9  F6= 10*cosd(alpha) //KN
10  x1= 6 //m
11  x2= 4.5 //m
12  x3= 1.2 //m
13  x4= 1.5 //m
14  x5= 4 //m
15  x6= 2 //m
16  //CALCULATIONS
17  Rah= F1+F2
18  Rav= ((-F5)*x2-x3*F1-F6*x4-F2*x3+F3*x5+F4*x6)/6
19  Rb= F3+F4-F5-Rav-F6
20  //RESULTS
21  printf ('Rah= %.1f kN',Rah)
22  printf (' \n Rav=%.1f KN',Rav)
23  printf (' \n Rb=%.1f KN',Rb)
```

Chapter 3

Normal Force Shear Force Bending Moment and Torsion

Scilab code Exa 3.1 chapter 3 example 1

```
1 clc
2 //initialisation of variables
3 Rah= -10 //KN
4 F= 10 //KN
5 //CALCULATIONS
6 Nab= -Rah
7 //RESULTS
8 printf ('Nab= %.f kN',Nab)
```

Scilab code Exa 3.2 chapter 3 example 2

```
1 clc
2 //initialisation of variables
3 Rah= -10 //KN
4 Fb= 10 //KN
5 //CALCULATIONS
```

```
6  Nab= -Rah
7  Nbc= Rah+Fb
8  //RESULTS
9  printf ('Nab= %.3f KN (tension)',Nab)
10 printf (' \n Nbc= %.2f KN',Nbc)
```

Scilab code Exa 3.3 chapter 3 example 3

```
1  clc
2  //initialisation of variables
3  Fb= -2 //KN
4  Fc= 6//KN
5  Fd= 4 //KN
6  a1= 60 //degrees
7  a2= 60 //degrees
8  //CALCULATIONS
9  Rah= Fd*cosd(a2)-Fc*cosd(a1)
10 Nac= Rah
11 Ncd= Fd*cosd(a2)
12 //RESULTS
13 printf ('Rah= %.3f KN',Rah)
14 printf (' \n Nac=%.2f KN(compression)',Nac)
15 printf (' \n Ncd=%.3f KN(tension)',Ncd)
```

Scilab code Exa 3.12 chapter 3 example 12

```
1  clc
2  //initialisation of variables
3  Mb= 10 //KN
4  Mc= -8 //KN
5  x1= 1 //m
6  x2= 2 //m
7  //CALCULATIONS
```

```
 8  Tab= Mb+Mc
 9  Tbc= Mc
10  //RESULTS
11  printf ('Tab= %.f KN ',Tab)
12  printf (' \n Tbc= %.f KN',Tbc)
```

Chapter 4

Analysis of Pin jointed Trusses

Scilab code Exa 4.2 chapter 4 example 2

```
1  clc
2  // initialisation of variables
3  F1= -2 //KN
4  F2= -3 //KN
5  F3= -1 //KN
6  x1= 2 //m
7  x2= 1.5 //m
8  x3= 1 //m
9  x4= 0.5 //m
10 //CALCULATIONS
11 Ra= (-F2*x4-F3*x3-F1*x2)/x1
12 Rd= -F1-F2-F3-Ra
13 Fab= -2.75/sind(60)
14 Fae= -Fab*cosd(60)
15 Fba= Fab
16 Fbe= (-2-Fba*cosd(30))/cosd(30)
17 Fbc= Fba*cosd(60)-Fbe*cosd(60)
18 Fdc= -Rd/sind(60)
19 Fde= -Fdc*cosd(60)
20 Fce= (-3-Fdc*cosd(30))/cosd(30)
21 //RESULTS
```

```
22  printf ('Ra= %.2 f KN',Ra)
23  printf (' \n Rd=%.2 f KN',Rd)
24  printf (' \n Fab=%.2 f KN( compression )',Fab)
25  printf (' \n Fae=%.2 f KN( tension )',Fae)
26  printf (' \n Fbe=%.2 f KN( tension )',Fbe)
27  printf (' \n Fbc=%.2 f KN( compression )',Fbc)
28  printf (' \n Fdc=%.2 f KN( compression )',Fdc)
29  printf (' \n Fde=%.2 f KN( tension )',Fde)
30  printf (' \n Fce=%.2 f KN( tension )',Fce)
```

Scilab code Exa 4.3 chapter 4 example 3

```
1  clc
2  // initialisation of variables
3  Re= -4 //KN
4  Rh= -6 //KN
5  Ro= 2 //KN
6  x1= 1 //m
7  x2= 3 //m
8  x3= 5 //m
9  x4= 4 //m
10 //CALCULATIONS
11 Rb= (Ro*x1-Re*x2-Rh*x3)/8
12 Rav= (-Ro*x1-Re*x3-Rh*x2)/8
13 Rah= Ro
14 Fcf= (Rav+Re)/cosd(45)
15 Fcd= (-Re*x1-Rav*x4-Ro*x1)/x1
16 Fef= (Rav*x2+Ro*x1)/x1
17 //RESULTS
18 printf ('Rb= %.1 f KN',Rb)
19 printf (' \n Rav=%.1 f KN',Rav)
20 printf (' \n Rah=%. f KN',Rah)
21 printf (' \n Fcf=%.2 f KN',Fcf)
22 printf (' \n Fcd=%. f KN',Fcd)
23 printf (' \n Fef=%.1 f KN',Fef)
```

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Scilab code Exa 4.4 chapter 4 example 4

```
 1  clc
 2  //initialisation of variables
 3  Rav= 1 //KN
 4  Re= 4 //KN
 5  Xac= 1.5 //m
 6  Xce= 1.5 //m
 7  Fd= -5 //KN
 8  Rah= -3 //KN
 9  xa= 0 //m
10  ya= 0 //m
11  xc= 1.5 //m
12  yc= 0//m
13  xe= 3 //m
14  ye= 0 //m
15  xf= 3 //m
16  yf= 1.5 //m
17  xd= 1.5 //m
18  yd= 1.5 //m
19  xb= 0 //m
20  yb= 1.5 //m
21  Yef= 1.5 //m
22  Fb= 3 //KN
23  //CALCULATIONS
24  tac= -Rah/(xc-xa)
25  tab= -Rav/(yb-ya)
26  tba= tab
27  tbc= -tba*(ya-yb)/(yc-yb)
28  tbd= (-Fb-tbc*(xc-xb))/(xd-xb)
29  tdb= tbd
30  tdf= -tdb*(xb-xd)/(xf-xd)
31  tdc= (-Fd-tdb*(yb-yd))/(yc-yd)
32  tec= 0
```

```
33  tfe= -Re/(yf-ye)
34  tfc= (-tdf*(xd-xf)-tfe*(xe-xf))/(xc-xf)
35  Tab= tab*(yb-ya)
36  Tac= tac*(xc-xa)
37  Tbc= tbc*sqrt((xb-xc)^2+(yb-yc)^2)
38  Tbd= tbd*(xd-xb)
39  Tdf= tdf*(xf-xd)
40  Tdc= tdc*(yd-yc)
41  Tfc= tfc*sqrt((xf-xc)^2+(yf-yc)^2)
42  Tfe= tfe*(yf-ye)
43  Tec= tec*(xe-xc)
44  //RESULTS
45  printf ('Tab= %.2f KN(compression)',Tab)
46  printf (' \n Tac=%.2f KN(tension)',Tac)
47  printf (' \n Tbc=%.2f KN(tension)',Tbc)
48  printf (' \n Tbd=%.2f KN(compression)',Tbd)
49  printf (' \n Tdf=%.2f KN(compression)',Tdf)
50  printf (' \n Tdc=%.2f KN(compression)',Tdc)
51  printf (' \n Tfc=%.2f KN(tension)',Tfc)
52  printf (' \n Tfe=%.2f KN(compression)',Tfe)
53  printf (' \n Tec=%.2f KN(tension)',Tec)
```

Scilab code Exa 4.6 chapter 4 example 6

```
1   clc
2   //initialisation of variables
3   xa= -2
4   ya= -2
5   za= -4
6   xb= -2
7   yb= -2
8   zb= 2
9   xc= 2
10  yc= -2
11  zc= -4
```

```
12  xd= 2
13  yd= -2
14  zd= 2
15  xf= 0
16  yf= 0
17  zf= 0
18  xe= 0
19  ye= 0
20  ze= -2
21  Fe= -60  //KN
22  Ff= 40  //KN
23  //CALCULATIONS
24  A=[(xd-xf),(xb-xf),(xe-xf);  (yd-yf),(yb-yf),(ye-yf);
        (zd-zf),(zb-zf),(ze-zf)]
25  b=[Ff;0;0]
26  c=A\b
27  tfd= c(1,1)
28  tfb= c(2,1)
29  tfe= c(3,1)
30  B=[(xb-xe),(xc-xe),(xa-xe);  (yb-ye),(yc-ye),(ya-ye);
        (zb-ze),(zc-ze),(za-ze)]
31  e=[0-tfe*(xf-xe);-Fe-tfe*(yf-ye);-tfe*(zf-ze)]
32  f=B\e
33  teb= f(1,1)
34  tec= f(2,1)
35  tea= f(3,1)
36  Lfb= sqrt((xb-xf)^2+(yb-yf)^2+(zb-zf)^2)
37  Lfd= sqrt((xd-xf)^2+(yd-yf)^2+(zd-zf)^2)
38  Lfe= sqrt((xe-xf)^2+(ye-yf)^2+(ze-zf)^2)
39  Lec= sqrt((xc-xe)^2+(yc-ye)^2+(zc-ze)^2)
40  Lea= sqrt((xa-xe)^2+(ya-ye)^2+(za-ze)^2)
41  Leb= sqrt((xb-xe)^2+(yb-ye)^2+(zb-ze)^2)
42  Tfb= tfb*Lfb
43  Tfd= tfd*Lfd
44  Tfe= tfe*Lfe
45  Tec= tec*Lec
46  Tea= tea*Lea
47  Teb= teb*Leb
```

```
48  //RESULTS
49  printf ('Tfb= %.1f KN(compression)',Tfb)
50  printf (' \n Tfd=%.1f KN(tension)',Tfd)
51  printf (' \n Tfe=%.1f KN',Tfe)
52  printf (' \n Tec=%.1f KN(compression)',Tec)
53  printf (' \n Tea=%.1f KN(compression)',Tea)
54  printf (' \n Teb=%.1f KN(compression)',Teb)
```

Chapter 5

Cables

Scilab code Exa 5.1 chapter 5 example 1

```
1  clc
2  // initialisation of variables
3  F= -10 //KN
4  x1= 1 //m
5  x2= 2 //m
6  x3= 3 //m
7  // CALCULATIONS
8  alpha= atand(x1/x3)
9  beta= atand(x1/x2)
10 Tca= -F*cosd(beta)
11 Tcb= Tca*cosd(alpha)/cosd(beta)
12 Rav= -F*x2/(x2+x3)
13 Rbv= -F-Rav
14 Rah= Rav*x3/x1
15 Rbh= Rah
16 Tca= sqrt(Rav^2+Rah^2)
17 Tcb= sqrt(Rbv^2+Rbh^2)
18 // RESULTS
19 printf ('Tca= %.1f KN',Tca)
20 printf (' \n Tcb=%.1f KN',Tcb)
21 printf (' \n Rav=%.f KN',Rav)
```

```
22  printf (' \n Rbv=%.f KN',Rbv)
23  printf (' \n Rah=%.f KN',Rah)
24  printf (' \n Tca=%.1f KN',Tca)
25  printf (' \n Tcb=%.1f KN',Tcb)
```

Scilab code Exa 5.2 chapter 5 example 2

```
1  clc
2  //initialisation of variables
3  Fc= -10.0 //KN
4  Fd= -6.0 //KN
5  y= 0.5 //m
6  x1= 1.5 //m
7  x2= 2.0 //m
8  x3= 1.8 //m
9  //CALCULATIONS
10 //The values in the textbook are rounded off. hence,
       there is a small variation in the result of this
       code.
11 alpha= atand(y/x1)
12 Rav= (-Fd*x3-Fc*(x2+x3))/(x1+x2+x3)
13 Rah= Rav*x1/y
14 Tca= sqrt(Rah^2+Rav^2)
15 tanbeta= ((-Fc-Tca*sind(alpha)))/(Tca*cosd(alpha))
16 Tcd= Tca*cosd(alpha)/cosd(beta)
17 gama= atand((-Fd+Tcd*sind(beta)))/(Tcd*cosd(beta))
18 Tdb= (Tcd*cosd(beta))/cosd(gama)
19 //RESULTS
20 printf ('Tca= %.1f KN',Tca)
21 printf (' \n Tcd=%.1f KN',Tcd)
22 printf (' \n Tdb=%.2f KN',Tdb)
```

Scilab code Exa 5.4 chapter 5 example 4

```
1  clc
2  // initialisation  of  variables
3  L= 200  //m
4  D= 18  //m
5  h= 6  //m
6  w= 10  //KN/m
7  //CALCULATIONS
8  L2= L/(sqrt((D-h)/D)+1)
9  H= w*L2^2/(2*D)
10 Tmax= sqrt((w*L2)^2+H^2)
11 alphamax= atand(w*L2/H)
12 printf ('L2= %.1f m',L2)
13 printf (' \n H=%.1f KN',H)
14 printf (' \n Tmax=%.1f KN',Tmax)
15 printf (' \n alphamax=%.1f degrees',alphamax)
```

Scilab code Exa 5.5 chapter 5 example 5

```
1  clc
2  // initialisation  of  variables
3  w= 120  //KN
4  D= 30  //m
5  L= 300  //m
6  sigmamax= 600  //N/mm^2
7  h= 50  //m
8  beta= 45  //degrees
9  //CALCULATIONS
10 Tmax= ((w*L)/2)*(sqrt(1+(L/(4*D))^2))
11 d= sqrt((4*Tmax*10^3)/(sigmamax*%pi))
12 H= (w*L^2)/(8*D)
13 alpha= atand((w*L)/(2*H))
14 Mt= Tmax*(cosd(alpha)-cosd(beta))*h
15 Vt= Tmax*(sind(alpha)+sind(beta))
16 Wa= Tmax*cosd(beta)
17 //RESULTS
```

```
18  printf ('Tmax= %.1f KN',Tmax)
19  printf (' \n d=%.1f mm',d)
20  printf (' \n H=%.0f KN',H)
21  printf (' \n alpha=%.1f degrees ',alpha)
22  printf (' \n Mt=%.0f KNm',Mt)
23  printf (' \n Vt=%.0f KN',Vt)
24  printf (' \n Wa=%.0f KN',Wa)
```

Chapter 6

Arches

Scilab code Exa 6.1 chapter 6 example 1

```
1 clc
2 //initialisation of variables
3 F1= -60 //KN
4 F2= -100 //KN
5 r= 6 //m
6 alpha1= 30 //degrees
7 alpha2= 45 //degrees
8 //CALCULATIONS
9 Rav= (-F1*(r*cosd(alpha1)+r)-F2*(r*sind(alpha1)+r) )
    /(2*r)
10 Rbv= -F1-F2-Rav
11 Rbh= Rbv
12 Rah= Rbh
13 Nx= -Rav*cosd(alpha2)-Rah*cosd(alpha2)-F1*cosd(
    alpha2)
14 Sx= -Rav*sind(alpha2)+Rah*cosd(alpha2)-F1*sind(
    alpha2)
15 Mx= Rav*(r-r*cosd(alpha2))-Rah*r*sind(alpha2)+F1*(r*
    cosd(alpha1)-r*cosd(alpha2))
16 //RESULTS
17 printf ('Normal force= %.1f KN',Nx)
```

```
18 printf ('\n  Shear force=%.1f KN',Sx)
19 printf (' \n Bending moment=%.1f KNm',Mx)
```

Scilab code Exa 6.2 chapter 6 example 2

```
1  clc
2  // initialisation of variables
3  W= -10 //KN/m
4  Yac= 7 //m
5  xad= -7.5 //m
6  xac= -15 //m
7  xcb= 10 //m
8  //CALCULATIONS
9  k= Yac/((xac)^2)
10 yb= k*(xcb)^2
11 hb= Yac-yb
12 yd= k*(xad)^2
13 hd= Yac-yd
14 A=[(xcb-xac),(hb);(xcb),(-yb)]
15 b=[-W*(-xac)*(-xad);0]
16 c= A\b
17 Rbv= c(1,1)
18 Rbh= c(2,1)
19 Rah= Rbh
20 Rav= -Rbv-W*(-xac)
21 dybydx= 2*k*xad
22 alpha= atand(-2*k*xad)
23 Nd= -Rav*sind(alpha)-Rah*cosd(alpha)+((-W)*(-xad)*
      sind(alpha))
24 Sd= -Rav*cosd(alpha)+Rah*sind(alpha)+((-W)*(-xad)*
      cosd(alpha))
25 Md= Rav*(-xad)-Rah*hd+W*(-xad)*(-xad/2)
26 //RESULTS
27 printf ('Normal force= %.2f kN',Nd)
28 printf ('\n  Shear force=%.2f KN',Sd)
```

```
29  printf (' \n Bending moment=%.1f KNm',Md)
```

Chapter 7

Stress and Strain

Scilab code Exa 7.1 chapter 7 example 1

```
1  clc
2  //initialisation of variables
3  P= 800*10^3
4  sigmamax= 400
5  //CALCULATIONS
6  Amin= P/sigmamax
7  B= sqrt(Amin/2)
8  //RESULTS
9  printf ('Amin= %.2 f mm^2',Amin)
10 printf (' \n B=%.2 f mm( Therefore the min dimensions
      of the column cross section are 31.6mm*63.2mm)',B
      )
```

Scilab code Exa 7.2 chapter 7 example 2

```
1  clc
2  //initialisation of variables
3  x1= %pi/4
```

```
4  y= 350^2-300^2
5  W= 2000*10^3
6  E= 200000
7  h= 5*10^3
8  //CALCULATIONS
9  A= x1*y
10 sigma= -(W/A)
11 epsilon= (sigma/E)
12 delta= -(epsilon*h)
13 //RESULTS
14 printf ('A= %.2f mm^2',A)
15 printf (' \n sigma=%.2f N/mm^2',sigma)
16 printf (' \n epsilon=%.5f ',epsilon)
17 printf (' \n delta=%.2f mm',delta)
```

Scilab code Exa 7.3 chapter 7 example 3

```
1  clc
2  //initialisation of variables
3  W= 10*10^3 //KN
4  L= 500 //mm
5  D= 200 //mm
6  T= 2 //mm
7  G= 25000 //N/mm^2
8  //CALCULATIONS
9  Tav= W/(D*T)
10 gama= Tav/G
11 deltas= gama*L
12 //RESULTS
13 printf ('Tav= %.2f N/mm^2',Tav)
14 printf (' \n gama=%.3f rad',gama)
15 printf (' \n deltas=%.2f mm',deltas)
```

Scilab code Exa 7.4 chapter 7 example 4

```
1  clc
2  //initialisation of variables
3  mu= 0.3
4  E= 200000 //N/mm^2
5  R= 0.1*10^-2
6  //CALCULATIONS
7  K= E/(3*(1-2*mu))
8  sigma= R*K
9  linearstrain= R/3
10 //RESULTS
11 printf ('K= %.f N/mm^2',K)
12 printf (' \n sigma=%.f N/mm^2',sigma)
13 printf (' \n linearstarin=%.5f ',linearstrain)
```

Scilab code Exa 7.5 chapter 7 example 5

```
1  clc
2  //initialisation of variables
3  x1= 4
4  x2= %pi/x1
5  L= 400 //mm
6  h= 5 //m
7  d=20 //mm
8  W= 1000*10^3 //KN
9  Ys= 200000 //N/mm^2
10 Yc= 15000 //N/mm^2
11 //CALCULATIONS
12 As= x1*x2*(d^2)
13 Ac= L^2-As
14 sigmas= (Ys*W)/(Ac*Yc+As*Ys)
15 sigmac= (Yc*W)/(Ac*Yc+As*Ys)
16 delta= (sigmac*h*10^3)/(Yc)
17 //RESULTS
```

```
18  printf ('As= %. f mm^2 ',As)
19  printf (' \n Ac=% f mm^2 ',Ac)
20  printf (' \n sigmas=%. f N/mm^2(stress in the steel)'
        ,sigmas)
21  printf (' \n sigmac=%.1 f N/mm^2(stress in the
        concrete)',sigmac)
22  printf (' \n delta;=%.1 f mm(shortening of the column
        )',delta)
```

Scilab code Exa 7.6 chapter 7 example 6

```
1   clc
2   //initialisation of variables
3   Ao= 2*300 //mm^2
4   Eo= 80000 //N/mm^2
5   Ei= 200000 //N/mm^2
6   Ai= 300 //mm^2
7   P= 100*10^3 //KN
8   deltaT= 100 //degrees
9   alphai= 1.2*10^-5 ///degreesc
10  alphao= 1.85*10^-5 ///degreesc
11  L= 4*10^3 //mm
12  //CALCULATIONS
13  sigmaiload= (Ei*P)/(Ao*Eo+Ai*Ei)
14  sigmaoload= (Eo*P)/(Ao*Eo+Ai*Ei)
15  sigmaotemp= (deltaT*(alphai-alphao)*Eo*Ai*Ei)/(Ao*Eo
        +Ai*Ei)
16  sigmaitemp= (deltaT*(alphai-alphao)*Eo*Ao*Ei)/(Ao*Eo
        +Ai*Ei)
17  sigmai= sigmaiload+sigmaitemp
18  sigmao= sigmaoload-sigmaotemp
19  deltaload= (P*L)/(Ao*Eo+Ai*Ei)
20  deltatemp= (L*deltaT)*(alphao*Ao*Eo+alphai*Ai*Ei)/(
        Ao*Eo+Ai*Ei)
21  displacement= deltatemp-deltaload
```

```
22  //RESULTS
23  printf ('sigmai= %.2f N/mm^2(stress in the column)',
        sigmai)
24  printf (' \n sigmao=% f N/mm^2(stress in the column)
        ',sigmao)
25  printf (' \n displacement=% f mm(elongation)',
        displacement)
```

Scilab code Exa 7.7 chapter 7 example 7

```
1  clc
2  //initialisation of variables
3  A= 120*300 //mm^2
4  At= 6*300 //mm^2
5  Ec= 150 //N/mm^2
6  Et= 150*15 //N/mm^2
7  P= 150*10^3 //N
8  //CALCULATIONS
9  Ac= A-At
10 sigmaci= (Ec*At)/Ac
11 F= Ac*sigmaci
12 stressintheconcrete= (sigmaci)-((Ec*P)/(Ac*Ec+At*Et)
        )
13 stressinthesteel= (F/At)+((Et*P)/(Ac*Ec+At*Et))
14 printf ('stressintheconcrete= %.1f N/mm^2(
        compression)',stressintheconcrete)
15 printf (' \n stressinthesteel=% f N/mm^2(tension)',
        stressinthesteel)
```

Scilab code Exa 7.8 chapter 7 example 8

```
1  clc
2  //initialisation of variables
```

```
3  sigmac= 400 //N/mm^2
4  fs= 6
5  d= 2*10^3 //mm
6  t= 20 //mm
7  E= 200000 //N/mm^2
8  mu= 0.3
9  //CALCULATIONS
10 p= (sigmac*2*t)/(d*6)
11 volumestrain= (p*d)*((5/4)-mu)/(t*E)
12 //RESULTS
13 printf ('p= %.2f N/mm^2',p)
14 printf (' \n volumestrain=% f percent',volumestrain)
```

Chapter 9

Bending of Beams

Scilab code Exa 9.1 chapter 9 example 1

```
1  clc
2  //initialisation of variables
3  w= 10 //KN/m
4  L= 6 //m
5  sigmaxallowable= 155 //N/mm^2
6  Modulusofuniversalbeam= 307600 //mm^3
7  Satisfactorybeam= 254*102*28
8  //CALCULATIONS
9  Mmaxnormal= (w*L^2)/8
10 Zemin= (Mmaxnormal)/sigmaxallowable
11 Totalload= w+((28*9.81)/10^3)
12 Mmaxload= (Totalload*L^2)/8
13 Allowablestress= (Mmaxload*10^3*10^3)/
      Modulusofuniversalbeam
14 //RESULTS
15 printf ('Satisafactorybeam=% 2f (254*102*28)',
      Satisfactorybeam)
```

Scilab code Exa 9.2 chapter 9 example 2

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```
1  clc
2  //initialisation of variables
3  M= 100*10^6  //Nmm
4  BeamB= 300  //mm
5  BeamL= 200  //mm
6  BeamT= 25  //mm
7  BeamT2= 20  //mm
8  //CALCULATIONS
9  Iz= ((BeamL*BeamB^3)/12)-((BeamL-BeamT)*(BeamB-2*
       BeamT2)^3)/12
10 sigmaxbyY= -M/Iz
11 SB= sigmaxbyY*(BeamB/2)
12 ST= sigmaxbyY*(-BeamB/2)
13 //RESULTS
14 printf ('Stress at top of the beam= %.2fN/mm^2(
       Tension)',ST)
15 printf ('\n Stress at bottom of the beam= %.2fN/mm
       ^2(compression)',SB)
```

Scilab code Exa 9.3 chapter 9 example 3

```
1  clc
2  //initialisation of variables
3  M= 100*10^6  //Nmm
4  BeamB= 300  //mm
5  BeamH= 200  //mm
6  BeamT= 25  //mm
7  BeamT2= 20  //mm
8  //CALCULATIONS
9  Iy= (2*BeamT2*BeamH^3/12)+((BeamB-2*BeamT2)*BeamT
       ^3/12)
10 alphabyz=-M/Iy
11 //RESULTS
12 printf ('sigmax= %.2f *z',alphabyz)
```

Scilab code Exa 9.4 chapter 9 example 4

```
1  clc
2  // initialisation of variables
3  BeamB= 300 //mm
4  BeamL= 200 //mm
5  BeamT= 25 //mm
6  BeamT2= 20 //mm
7  alpha= 30 //degrees
8  Mz= 100*10^6*cosd(alpha)//Nmm
9  My= 100*10^6*sind(alpha)//Nmm
10 //CALCULATIONS
11 Iz= ((BeamL*BeamB^3)/12)-((BeamL-BeamT)*(BeamB-2*
      BeamT2)^3)/12
12 Iy= (2*BeamT2*BeamL^3/12)+((BeamB-2*BeamT2)*BeamT
      ^3/12)
13 sigmaxtl= (+Mz/Iz)*(BeamB/2)+(My/Iy)*(BeamH/2)
14 sigmaxtr= (+Mz/Iz)*(BeamB/2)+(My/Iy)*(-BeamH/2)
15 inclination= atand((My*Iz)/(Mz*Iy))
16 //RESULTS
17 printf ('Stress at top left of the beam= %.2fN/mm^2(
      Tension)',sigmaxtl)
18 printf ('\n Stress at top right of the beam= %.2fN/
      mm^2(compression)',sigmaxtr)
19 printf ('\n Incination= %.2fdegrees',inclination)
```

Scilab code Exa 9.5 chapter 9 example 5

```
1  clc
2  // initialisation of variables
3  BeamB= 200 //mm
4  BeamH= 200 //mm
```

```
 5  BeamT= 20  //mm
 6  BeamT2= 20  //mm
 7  sigmaxtop= 150  //N/mm^2
 8  sigmaxbottom= -150  //N/mm^2
 9  //CALCULATIONS
10  y= ((BeamB*BeamT*BeamT/2)+(BeamH*BeamT2*((BeamH/2)+
       BeamT)))/(BeamB*BeamT+BeamH*BeamT2)
11  Iz= ((BeamB*(y^3))/3)-(((BeamB-BeamT2)*(y-BeamT)^3)
       /3)+(BeamT2*((BeamH+BeamT-y)^3)/3)
12  P1= sigmaxtop/(((1/(BeamB*BeamT+BeamH*BeamT2))+((y-
       BeamT/2)*y/Iz))
13  P2= (sigmaxbottom/(((1/(BeamB*BeamT+BeamH*BeamT2))+((
       y-BeamT/2)*(-(BeamH+BeamT-y))/Iz)))
14  if(P1>P2)
15      disp(P2)
16  else
17      disp(P1)
18  end
```

Scilab code Exa 9.6 chapter 9 example 6

```
 1  clc
 2  //initialisation of variables
 3  Height= 7  //m
 4  Thickness= 0.6  //m
 5  density= 2000  //Kg/m^3
 6  //CALCULATIONS
 7  W= density*9.81*Thickness*Height
 8  p= 0.1*W*2/(Height*Height)
 9  //RESULTS
10  printf ('p= %.2f N/m^1',p)
```

Scilab code Exa 9.8 chapter 9 example 8

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```
 1  clc
 2  //initialisation of variables
 3  M= 1500 //Nm
 4  x1= 40 //mm
 5  x2= 80 //mm
 6  x3= 8 //mm
 7  y1= 8 //mm
 8  y2= 80 //mm
 9  //CALCULATIONS
10  Ycentroid= (((x1+x2)*y1*y1/2)+(y2*x3*((y2/2)+y1)))
      /((x1+x2)*y1+y2*x3)
11  Zcentroid= (((y2*x3*y1/2)+((x1+x2)*x3*((y2/2)+y1)/2)
      )/((x1+x2)*y1+y2*x3))
12  Iz= (((x1+x2)*(y1)^3)/12)+(x1+x2)*y1*((Ycentroid-(y1
      /2))^2)+(x3/12)*(y2^3)+y2*x3*((y2/2)-(Ycentroid-
      y1))^2
13  Iy= (y1*(((x1+x2)^3)/12))+(x1+x2)*y1*(y1^2)+((x3^3)
      /12)*(y2)+y2*x3*((Zcentroid-(x3/2))^2)
14  Izy= (x1+x2)*y1*(-y1)*(Ycentroid-(y1/2))+y2*x3*(
      Zcentroid-(x3/2))*(-(y2/2)+(Ycentroid-y1))
15  sigmax= ((-M*10^3*Izy*x3)+(-M*10^3*Iy*(y2-Ycentroid+
      y1)))/((Iz*Iy)-(Izy)^2)
16  //RESULTS
17  printf ('Maximum direct stress= %.2f N/mm^2',sigmax)
```

Chapter 11

Torsion of Beams

Scilab code Exa 11.1 chapter 11 example 1

```
1  clc
2  //initialisation of variables
3  Lab= 2 //m
4  Lbc= 0.5 //m
5  Dab= 200 //mm
6  Dbc= 100 //mm
7  T= 50 //KNm
8  G= 80000 //N/mm^2
9  //CALCULATIONS
10 Jab= %pi*Dab^4/32
11 Jbc= %pi*Dbc^4/32
12 Tc= T/((Lbc*Jab)/(Lab*Jbc)+1)
13 Ta= T-Tc
14 if(Dab<Dbc)
15     Dbc=Dab;Tc=Ta;
16 else
17     Dab=Dab;Tc=Tc
18 end
19 Stressmax= (Tc*10^6*Dbc*32)/(2*%pi*Dbc^4)
20 angleoftwist= Ta*10^6*Lab*32*10^3*180/(G*%pi*Dab^4*
       %pi)
```

```
21 //RESULTS
22 printf ('Stress max= %.1f N/mm^2',Stressmax)
23 printf (' \n Anlge of twist=% 2f degrees',
       angleoftwist)
```

Scilab code Exa 11.2 chapter 11 example 2

```
1 clc
2 //initialisation of variables
3 d= 200 //mm
4 l= 2 //m
5 Shearstressmax= 200 //N/mm^2
6 Maximumangleoftwist= 2 //degrees
7 Maxtorque= 30/2 //KNm
8 G= 25000 //N/mm^2
9 //CALCULATIONS
10 tmin= (Maxtorque*10^6*4)/(2*%pi*d^2*Shearstressmax)
11 x1=l/2
12 c=0
13 dtbydx= (Maxtorque*%pi*200*16)/(4*%pi^2*d^4*G*tmin)
14 theta= (Maxtorque*%pi*200*16)/(4*%pi^2*d^4*G*tmin)*
       x1+c
15 tminimum= (Maxtorque*%pi*200*10^9*180*16)/(4*%pi^2*d
       ^4*G*Maximumangleoftwist*%pi)*x1
16 //RESULTS
17 printf ('minimum allowable thickness= %.1f mm',
       tminimum)
```

Scilab code Exa 12.8 chapter 12 example 8

```
1 clc
2 b=250 //mm
3 BM=350*10^3 //Nm
```

```
4  SigmaCu=30  //N/mm^2
5  SigmaY=400  //N/mm^2
6  d1=sqrt(BM*10^3 /(0.15*SigmaCu*b))
7  lever=3*d1/4
8  As=BM*10^3/(0.87*SigmaY*lever)
9  printf("As=%f mmm^2",As)
```

Chapter 12

Composite Beams

Scilab code Exa 12.1 chapter 12 example 1

```
1  clc
2  //initialisation of variables
3  TimberB= 100 //mm
4  TimberH= 400 //mm
5  SteelB= 12 //mm
6  SteelH= 300 //mm
7  Bm= 50 //KNm
8  ratio= 12
9  //CALCULATIONS
10 It= 2*TimberB*TimberH^3/12
11 Is= ratio*SteelH^3/12
12 sigmat= -(Bm*10^6*TimberH/2)/(It+ratio*Is)
13 sigmas= -(Bm*10^6*SteelH/2)/(Is+It/ratio)
14 //RESULTS
15 printf ('Maximum stress in timber= %.1 f mm^2 (+ or
       -)',sigmat)
16 printf (' \n Maximum stress in steel=%.1 f N/mm^2 (+
       or -)',sigmas)
```

Scilab code Exa 12.2 chapter 12 example 2

```
1  clc
2  TimberB=100  //mm
3  TimberH=200  //mm
4  It=TimberB*TimberH^3 /12
5  SteelB=15  //mm
6  SteelH=100  //mm
7  ratio=15
8  Is=2*SteelB*SteelH*(SteelH+SteelB/2)^2
9  Load=10  //KN/m
10 Span=4  //m
11 Mmax=Load*Span^2 *10^6 /8  //Nm
12 sigmaT=Mmax*TimberH/2/(It+ratio*Is)
13 sigmaS=Mmax*(SteelH+SteelB)/(Is+It/ratio)
14 printf("The maximum stress in Timber=%f N/mm^2",
        sigmaT)
15 printf(" \n The maximum stress in Steel=%f N/mm^2",
        sigmaS)
16 Shear=Load*Span/2
17 printf("Max. Shear force in beam at the supports =
        %f kN", Shear)
18 Tav=Mmax/(TimberH*TimberB)
19 ShearPerlength=Tav*TimberB
20 printf("\n Shear force per unit length in timber/
        steel connection= %f N/m",ShearPerlength)
```

Scilab code Exa 12.3 chapter 12 example 3

```
1  clc
2  b=200  //mm
3  d=350  //mm
4  dia=20  //mm
5  BM=30*10^3  //Nm
6  m=15
```

```
7  As=2*%pi*dia^2 /4
8  n=m*As*(sqrt(1+ 2*b*d/(m*As))-1)/b
9  Ic=b*n^3 /3 + m*As*(d-n)^2
10 SigmaC=-BM*n*10^3/Ic
11 printf("Stress in concrete=%f N/mm^2 compression",
       SigmaC)
12 SigmaS=m*BM*10^3*(d-n)/Ic
13 printf("\n Stress in Steel=%f N/mm^2 tension",SigmaS
       )
```

Scilab code Exa 12.4 chapter 12 example 4

```
1  clc
2  b=250 //mm
3  d=400 //mm
4  dia=20 //mm
5  n=3
6  SigmaC=7 //N/mm^2
7  SigmaS=140 //N/mm^2
8  m=15
9  As=n*%pi*dia^2 /4
10 n=m*As*(sqrt(1+ 2*b*d/(m*As))-1)/b
11 BMC=SigmaC*b*n*(d-n/3)*10^(-6) /2
12 BMS=SigmaS*As*(d-n/3)*10^(-6)
13 if BMC>=BMS then
14     printf("Limiting material is Steel and moment of
             resistance of the beam is %f",BMS)
15 else
16     printf("Limiting material is Concrete and moment
             of resistance of the beam is %f",BMC)
17 end
```

Scilab code Exa 12.5 chapter 12 example 5

```
1  clc
2  d=400  //mm
3  m=15
4  ASs=120  //N/mm^2
5  ASc=6.5  //N/mm^2
6  BM=40*10^3  //Nm
7  n=d/(ASs/(ASc*m) +1 )
8  As=BM*10^3/(ASs*(d-n/3))
9  printf("required area= %f mm^2",As)
```

Scilab code Exa 12.6 chapter 12 example 6

```
1  clc
2  b=180  //mm
3  d=360  //mm
4  m=15
5  BM=45*10^3  //Nm
6  depth=40  //mm
7  Sc=8.5  //N/mm^2
8  Ss=140  //N/mm^2
9  n=d/(Ss/(Sc*m) +1 )
10 Ast=(BM*10^3 - Sc*b*n*(n/3 - depth)/2)/(Ss*(d-depth)
      )
11 Asc=(m*Ast*(d-n) - b*n^2 /2 )/((m-1)*(n-depth))
12 SigmaSC=-m*(n-depth)*Sc/n
13 printf("Area of reinforcement steel = %f mm^2",Ast)
14 printf("\n Area of reinforcement concrete= %f mm^2",
      Asc)
15 printf("\n Stress in compresson steel=%f N/mm^2
      compression",SigmaSC)
```

Scilab code Exa 12.7 chapter 12 example 7

```
1  //CLC
2  d= 600 //mm
3  b= 250 //mm
4  BM= 350 //KNm
5  t= 28
6  Sc= 30 //N/mm^2
7  T= 400 //N/mm^2
8  //CALCULATIONS
9  Mu= 0.15*Sc*b*d^2*10^-6
10 n= d-sqrt(d^2-(2*BM*10^6/(0.4*Sc*b)))
11 l= d-(n/2)
12 As= BM*10^6/(l*T*0.87)
13 //RESULTS
14 printf("As(mm^2) = %.2f",As)
```

Scilab code Exa 12.8 chapter 12 example 8

```
1  clc
2  b=250 //mm
3  BM=350*10^3 //Nm
4  SigmaCu=30 //N/mm^2
5  SigmaY=400 //N/mm^2
6  d1=sqrt(BM*10^3 /(0.15*SigmaCu*b))
7  lever=3*d1/4
8  As=BM*10^3/(0.87*SigmaY*lever)
9  printf("As=%f mmm^2",As)
```

Scilab code Exa 12.9 chapter 12 example 9

```
1  clc
2  b=300 //mm
3  d=618 //mm
4  depth=60 //mm
```

```
5  SigmaCu =30  //N/mm^2
6  SigmaY =410  //N/mm^2
7  BM=650  //Nm
8  Mu=0.15*SigmaCu*b*d^2 *10^(-6)
9  Asc =(BM-Mu)*10^6 /((d-depth)*0.72*SigmaY)
10 Ast=Mu*10^6/(0.75*d*SigmaY*0.87) + (BM-Mu)*10^6/((d-
       depth)*0.87*SigmaY)
11 printf("Asc=%f mm^2",Asc)
12 printf("\n  Ast=%f mm^2",Ast)
```

Scilab code Exa 12.10 chapter 12 example 10

```
1  //CLC
2  w= 1200  //mm
3  d= 618  //mm
4  t= 150  //mm
5  BM= 500  //KNm
6  Scu= 30  //N/mm^2
7  Sy= 410  //mm^2
8  //CALCULATIONS
9  Mu= 0.4*Scu*w*t*(d-(t/2))*10^-6
10 n= d-sqrt(d^2-(2*BM*10^6/(0.4*Scu*w)))
11 l= d-(n/2)
12 As= BM*10^6/(0.87*Sy*l)
13 //RESULTS
14 printf("As(mm^2) = %.2f",As)
```

Scilab code Exa 12.11 chapter 12 example 11

```
1  clc
2  thick =150  //mm
3  width =1.8  //m
4  depth =562  //mm
```

```
 5  SigmaCu =30  //N/mmˆ2
 6  SigmaY =350  //N/mmˆ2
 7  BM=709  //KNm
 8  As =2* BM *10^6  /(0.87* SigmaY * depth )
 9  Tensile =0.87* SigmaY * As
10  disp ( Tensile )
11  Compressive =0.4* width * thick * SigmaCu *10^3
12  disp ( Compressive )
13  n1 =0.87* SigmaY *8530/(0.4* SigmaCu * width *10^3)
14  disp ( n1 )
15  Mu =0.87* SigmaY *8530*( SigmaY +6 - n1 /2) *10^( -6)
16  printf (" Mu=%f KNm" ,Mu)
17  printf ("\n This  is  greater  than  applied  moment .
        hence  it  is  satisfactory ")
```

Chapter 14

Complex stress and Strain

Scilab code Exa 14.1 chapter 14 example 1

```
1  clc
2  // initialisation of variables
3  d= 2  //m
4  t= 20  //mm
5  p= 1.5  //N/mm^2
6  load= 2500  //KN
7  alpha= 60  //degrees
8  //CALCULATIONS
9  Cs= (p*d*10^3)/(2*t)
10 Ls= (p*d*10^3)/(4*t)
11 Ds= (load*10^3)/(%pi*d*t*10^3)
12 Ts= Ls+Ds
13 sigman= (Ts*t*(cosd(90-alpha))^2+Cs*t*(cosd(alpha))
     ^2)/t
14 tab= Ts*sind(alpha)*cosd(alpha)-Cs*sind(alpha)*cosd(
     alpha)
15 tmax= (Ts-Cs)/2
16 //RESULTS
17 printf ('direct stress= %.1f N/mm^2',sigman)
18 printf (' \n Shear stress=%.1f N/mm^2',tab)
19 printf (' \n maximum Shear stress=%.1f N/mm^2',tmax)
```

Scilab code Exa 14.2 chapter 14 example 2

```
1  clc
2  //initialisation of variables
3  load= 50000 //N
4  torque= 1200 //Nm
5  d= 60//mm
6  t= 1.5 //mm
7  alpha= 60 //degrees
8  //CALCULATIONS
9  BM= load*t
10 axialload= (load*4)/(%pi*d^2)
11 bendingmoment= (BM*d*64)/(%pi*d^4*2)
12 Ts= axialload+bendingmoment
13 shearstress= (torque*10^3*d*32)/(2*%pi*d^4)
14 sigman= -Ts*(cosd(alpha-30))^2+shearstress*cosd(
       alpha-30)*sind(alpha-30)+shearstress*cosd(alpha
       -30)*sind(alpha-30)
15 T= -Ts*sind(alpha)*cosd(alpha)-shearstress*(sind(
       alpha))^2+shearstress*(cosd(alpha)^2)
16 //RESULTS
17 printf ('direct stress= %.1f N/mm^2',sigman)
18 printf (' \n Shear stress=%.1f N/mm^2',T)
```

Scilab code Exa 14.3 chapter 14 example 3

```
1  clc
2  //initialisation of variables
3  directstress= 80 //N.mm^2
4  shearstress= 45 //N/mm^2
5  //CALCULATIONS
```

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```
 6  Sx= directstress
 7  Sy= 0
 8  Txy= shearstress
 9  sigma1= ((Sx+Sy)/2)+(sqrt((Sx-Sy)^2+4*Txy^2))/2
10  sigma2= ((Sx+Sy)/2)-(sqrt((Sx-Sy)^2+4*Txy^2))/2
11  theta= (atand(-((2*Txy)/(Sx-Sy))))/2
12  direction1= theta
13  direction2= theta-90
14  Tmax= (sigma1-sigma2) /2
15  theta1= direction1-45
16  theta2= direction2-45
17  //RESULTS
18  printf ('principal stress1= %.1f N/mm^2',sigma1)
19  printf (' \n principal stress2=%.1f N/mm^2',sigma2)
20  printf (' \n direction of principal stress1=%.1f
       degrees',direction1)
21  printf (' \n.direction of principal stress2=%.1f
       degrees',direction2)
22  printf (' \n.maximum shear stress=%.1f N/mm^2',Tmax)
23  printf (' \n.derection of plane1=%.1f degrees',
       theta1)
24  printf (' \n.derection of plane2=%.1f degrees',
       theta2)
```

Scilab code Exa 14.5 chapter 14 example 5

```
1  clc
2  // initialisation of variables
3  sigmax= 60 //N/mm^2
4  sigmay= -40 //N/mm^2
5  Txy= 50 //N/mm^2
6  E= 200000 //N/mm^2
7  mu= 0.3
8  //CALCULATIONS
9  Sx= (sigmax-mu*sigmay)/E
```

```
10  Sy= (sigmay-mu*sigmax)/E
11  G= E/(2*(1+mu))
12  gamaxy= Txy/G
13  e1= ((Sx+Sy)/2+(sqrt((Sx-Sy)^2+(gamaxy)^2))/2)
14  e2= ((Sx+Sy)-(sqrt((Sx-Sy)^2+gamaxy^2)))/2
15  theta= atand(-gamaxy/(Sx-Sy))/2
16  theta1= -90+theta
17  //RESULTS
18  printf ('direct strain in x direction= %.2e ',Sx)
19  printf (' \n direct strain in y direction=%.2e ',Sy)
20  printf (' \n Gamaxy=%.2e ',gamaxy)
21  printf (' \n.principal strain1=%.9e ',e1)
22  printf (' \n.principal strain2=%.9e ',e2)
23  printf (' \n.direction of plane1=%.1f degrees',theta
         )
24  printf (' \n.direction of plane2=%.1f degrees',
         theta1)
```

Scilab code Exa 14.6 chapter 14 example 6

```
1  clc
2  //initialisation of variables
3  ea= 1000*10^-6
4  eb= -200*10^-6
5  ec= -300*10^-6
6  sigmay= 0 //N/mm^2
7  E= 70000 //N/mm^2
8  mu= 0.3
9  d= 50 //mm
10 //CALCULATIONS
11 e1= ((ea+ec)/2)+sqrt((((ea-eb)^2+(ec-eb)^2)/2)
12 e2= ((ea+ec)/2)-sqrt((((ea-eb)^2+(ec-eb)^2)/2)
13 sigma1= (E*(e1+mu*e2))/(1-mu^2)
14 sigma2= (E*(e2+mu*e1))/(1-mu^2)
15 sigmax= sigma1+sigma2
```

```
16 Txy= sqrt(((((sigma1*2)-(sigmax))^2-(sigmax^2)))/2
17 P= sigmax*((%pi/4)*(d^2))
18 T= Txy*((%pi/32)*(50^4)/25)
19 //RESULTS
20 printf ('T= %.2fNm',T)
21 printf ('\n P= %.2fN',P)
```

Scilab code Exa 14.7 chapter 14 example 7

```
1  clc
2  //initialisation of variables
3  sigmax= 140 //N/mm^2
4  sigmay= -70 //N/mm^2
5  Txy= 60 //N/mm^2
6  T= 225 //N/mm^2
7  //CALCULATIONS
8  sigma1= (sigmax+sigmay)/2+(sqrt((sigmax-sigmay)
       ^2+4*(Txy^2)))/2
9  sigma2= (sigmax+sigmay)/2-(sqrt((sigmax-sigmay)
       ^2+4*(Txy^2)))/2
10 sigmaY= sigma1-sigma2
11 sigmaY1= sqrt(sigma1^2+sigma2^2-sigma1*sigma2)
12 if(sigmaY>T)
13     disp("Tresca theory failure has ocurred")
14 else
15     disp("Tresca theory failed")
16 end
17 if(sigmaY1<T)
18     disp("According to Von Mises theory material has
           not failed")
19 else
20     disp("According to Von Mises theory material has
           failed")
21 end
```

Scilab code Exa 14.8 chapter 14 example 8

```
1  clc
2  //initialisation of variables
3  M= 250 //KNm
4  Torquemax= 200 //KNm
5  allowablestress= 180 //N/mm^2
6  L=250 //mm
7  B= 500 //mm
8  t= 10 //mm
9  t1= 12 //mm
10 //CALCULATIONS
11 Stressmax= (Torquemax*10^6)/(2*B*L*t)
12 I= (2*t1*L*L^2)+((2*t*B^3)/12)
13 sigma= (M*10^6*B)/(2*I)
14 Stressallowable= sqrt(sigma^2+3*(Stressmax^2))
15 if(Stressallowable<allowablestress)
16     disp("Box grider section is satisfactory")
17 else
18     disp("Box grider section is  not satisfactory")
19 end
```

Scilab code Exa 14.9 chapter 14 example 9

```
1  clc
2  //initialisation of variables
3  BeamL= 60 //mm
4  BeamB= 100 //mm
5  Load= 60000 //N
6  Stress=  150 //N/mm^2
7  //CALCULATIONS
8  sigmax= Load/(BeamL*BeamB)
```

```
 9  stressmax1= sqrt((Stress/2)^2-(sigmax^2/4))
10  Sy1= (2*stressmax1*BeamL*BeamB)/3
11  stressmax2= sqrt((Stress^2-(sigmax^2/4))/3-(sigmax
       ^2/4))
12  Sy2= (2*stressmax2*BeamL*BeamB)/3
13  //RESULTS
14  printf ('Shear force using Tresca= %.2e N',Sy1)
15  printf (' \n Shear force using Von Misses=%.2e N',
       Sy2)
```

Scilab code Exa 14.10 chapter 14 example 10

```
 1  clc
 2  //initialisation of variables
 3  BeamL= 250 //mm
 4  BeamH= 500 //mm
 5  spanlength= 4 //m
 6  Failurestress= 1.5 //N/mm^2
 7  //CALCULATIONS
 8  W1= (Failurestress*BeamL*BeamH^3)/(10^3*BeamL*12)
 9  W2= (4*Failurestress*BeamL*BeamH)/3
10  if(W1>W2)
11      printf ("W2= %.2e kN",W2)
12  else
13      printf ("W2= %.2e kN",W1)
```

Chapter 15

Virtual Work and Energy Methods

Scilab code Exa 15.3 chapter 15 example 3

```
1  clc
2  //initialisation of variables
3  Xae= 3 //m
4  Ycd= 4 //m
5  Yde= 4 //m
6  Fc= 30 //KN
7  //CALCULATIONS
8  Fba= Fc*Ycd/Xae
9  //RESULTS
10 printf ('Fba= %.2fKN',Fba)
```

Chapter 16

Analysis of Statically Indeterminate Structures

Scilab code Exa 16.1 chapter 16 example 1

```
1  clc
2  // initialisation of variables
3  M= 4
4  N= 3
5  r= 5
6  //CALCULATIONS
7  Ns= 3*(M-N+1)-r
8  nk= 3*N-M
9  //RESULTS
10 printf ('Ns= %.f ',Ns)
11 printf (' \n Nk= %.f ',nk)
```

Scilab code Exa 16.2 chapter 16 example 2

```
1  clc
2  // initialisation of variables
```

55

```
3  M= 17
4  N= 8
5  r= 27
6  st= 3
7  pt= 2
8  n= 8
9  //CALCULATIONS
10 ns= 3*(M-N+1)-r
11 nk= n*pt-st
12 //RESULTS
13 printf ('Ns= %.f ',ns)
14 printf (' \n Nk= %.f ',nk)
```

Scilab code Exa 16.3 chapter 16 example 3

```
1  clc
2  //initialisation of variables
3  M= 7
4  N= 6
5  r= 3
6  n= 6
7  df= 3
8  //CALCULATIONS
9  ns= 3*(M-N+1)-r
10 nk= n*df-r
11 //RESULTS
12 printf ('Ns= %.f ',ns)
13 printf (' \n Nk= %.f ',nk)
```

Scilab code Exa 16.4 chapter 16 example 4

```
1  clc
2  //initialisation of variables
```

```
 3  M= 19
 4  N= 13
 5  r= 0
 6  n= 6
 7  no= 13
 8  c= 24
 9  //CALCULATIONS
10  ns= n*(M-N+1)-r
11  nk= n*no-c
12  //RESULTS
13  printf ('Ns= %.f ',ns)
14  printf (' \n Nk= %.f ',nk)
```

Scilab code Exa 16.7 chapter 16 example 7

```
 1  clc
 2  //initialisation of variables
 3  F1= -6  //KN
 4  F2= -10  //KN
 5  W= -12  //KN/m
 6  E= 200000  //N/mm^2
 7  I= 12000  //mm^4
 8  x1= 0.5  //m
 9  x2= 0.5  //m
10  x3= 0.5  //m
11  x4= 0.5  //m
12  x5= 1.0  //m
13  //CALCULATIONS
14  vb0= 8.88/(E*I)
15  vc0= 9.089/(E*I)
16  a11= 0.45/(E*I)
17  a21= 0.39/(E*I)
18  a22= a11
19  a12= a21
20  A=[0.45 0.39;0.39 0.45]
```

```
21  b=[8.88;9.08]
22  c=A\b
23  R1=c(1,1)
24  R2=c(2,1)
25  Ra= -((F1*(x2+x3+x4+x5)+R1*(x3+x4+x5)+F2*(x4+x5)+R2
       *(x5)+(W*x5)*(x5/2)))/(x1+x2+x3+x4+x5)
26  Rd= -F1-F2-W*x5-R1-R2-Ra
27  //RESULTS
28  printf ('R1= %.2 f KN',R1)
29  printf (' \n R2=%.2 f KN',R2)
30  printf (' \n Ra=%.2 f KN',Ra)
31  printf (' \n Rd=%.2 f KN',Rd)
```

Scilab code Exa 16.13 chapter 16 example 13

```
 1  clc
 2  //initialisation of variables
 3  W= -10 //KN/m
 4  r= 5 //m
 5  //CALCULATIONS
 6  Rav= -W*2*r/2
 7  Rbv= Rav
 8  function[y]=conv(x)
 9      y=125*(sin(x))^2*5*(sin(x))*5
10  endfunction
11  v=intg(0,%pi,conv)
12  function[y]=conk(x)
13      y=25*(sin(x))^2*5
14  endfunction
15  k=intg(0,%pi,conk)
16  Rbh= v/k
17  Rah= Rbh
18  //RESULTS
19  printf ('Rav= %.2 f KN',Rav)
20  printf (' \n Rbv=%.2 f KN',Rbv)
```

```
21  printf ( ' \n Rah=%.2 f KN ' , Rah )
22  printf ( ' \n Rbh=%.2 f KN ' , Rbh )
```

Scilab code Exa 16.18 chapter 16 example 18

```
 1  //CLC
 2  x1= 7  //m
 3  x2= 7  //m
 4  x3= 4  //m
 5  x4= 4  //m
 6  x5= 4  //m
 7  x6= 12  //m
 8  x7= 4  //m
 9  Fab= 12  //KN
10  Fbc1= 7  //KN
11  Fbc2= 7  //KN
12  Fcd= 22  //KN
13  Fe= 5  //KN
14  //CALCULATIONS
15  MfAB= -Fab*(x1+x2)/(x3+x4)
16  MfBC= -(Fbc1*x3*(x4+x5)^2/(x6)^2)-(Fbc2*x3^2*(x4+x5)
      /(x6)^2)
17  MfCD= -Fcd*x6/x6
18  MfDE= -Fe*x7
19  DFba= (3/(x1+x2))/((3/(x1+x2))+(4/(x3+x4+x5)))
20  DFbc= 1-DFba
21  DFcb= (4/(x3+x4+x5))/((3/(x6))+(4/(x3+x4+x5)))
22  DFcd= 1-DFcb
23  //RESULTS
24  printf(" DFba = %.2 f " ,DFba)
25  printf(" DFbc = %.2 f " ,DFbc)
26  printf(" DFcb = %.2 f " ,DFcb)
27  printf(" DFcd = %.2 f " ,DFcd)
```

Scilab code Exa 16.19 chapter 16 example 19

```
1  clc
2  //initialisation of variables
3  W1= 5 //KN/m
4  W2= 5 //KN/m
5  F= -40 //KN
6  l1= 6 //m
7  l2= 5 //m
8  l3= 5 //m
9  l4= 6 //m
10 //CALCULATIONS
11 Mfab= -W1*l1^2/12
12 Mfbc= F*l2/8
13 DFab= (3/l1)/((3/l1)+(2/(l2+l3)))
14 DFbc= 1-DFab
15 //RESULTS
16 printf ('MFab= %.f KN m',Mfab)
17 printf (' \n MFbc= %.f KN m',Mfbc)
18 printf (' \n DFab= %.2f ',DFab)
19 printf (' \n DFbc= %.2f.',DFbc)
```

Scilab code Exa 16.20 chapter 16 example 20

```
1  clc
2  //initialisation of variables
3  W= 6 //KN/m
4  F= 40 //KN
5  l1= 5 //m
6  l2= 3 //m
7  l3= 3 //m
8  l= 12 //mm
```

```
9   Smab= 9*10^6  //mm^4
10  Smbc= 12*10^6  //mm^4
11  E= 200000  //N/mm^2
12  //CALCULATIONS
13  MFab= (-W*l1^2/12)+((-W*Smab*E*l))/((l1*10^3)
        ^2*10^6)
14  MFba= (W*l1^2/12)+((-W*Smab*E*l))/((l1*10^3)^2*10^6)
15  MFbc= -(F*(l2+l3)/8)+(3*E*Smbc*l)/(((l2+l3)*10^3)
        ^2*10^6)
16  MFcb= (F*(l2+l3)/8)
17  DFba= ((4*E*Smab)/l1)/(((4*E*Smab)/l1)+((3*E*Smbc)/(
        l2+l3)))
18  DFbc= 1-DFba
19  //RESULTS
20  printf ('MFab= %.1f KN m',MFab)
21  printf (' \n MFbc= %.1f KN m',MFba)
22  printf (' \n MFbc= %.1f KN m',MFbc)
23  printf (' \n MFbc= %.1f KN m',MFcb)
24  printf (' \n DFab= %.2f ',DFba)
25  printf (' \n DFbc= %.2f.',DFbc)
```

Scilab code Exa 16.21 chapter 16 example 21

```
1   //CLC
2   x1= 4  //m
3   x2= 4  //m
4   x3= 4  //m
5   x4= 16  //m
6   F1= 12  //KN
7   F2= 12  //KN
8   F3= 1  //KNm
9   y= 12  //m
10  //CALCULATIONS
11  MFab= -(F1*x1*(x2+x3)^2/(y)^2)-(F2*x3^2*(x1+x2)/(y)
        ^2)
```

```
12  MFbc= -F3*x4^2/y
13  DFad= (4/y)/((4/(x1+x2+x3))+(4/y))
14  DFab= 1-DFad
15  DFba=  (4/(x1+x2+x3))/((4/x4)+(3/y)+(4/(x1+x2+x3)))
16  DFbc= (4/x4)/((4/x4)+(3/y)+(4/(x1+x2+x3)))
17  DFbe= 1-DFba-DFbc
18  //RESULTS
19  printf("DFab = %.2f",DFab)
20  printf("DFbc = %.2f",DFbc)
21  printf("DFba = %.2f",DFba)
22  printf("DFad = %.2f",DFad)
```

Scilab code Exa 16.22 chapter 16 example 22

```
 1  //CLC
 2  x1= 5  //m
 3  x2= 10  //m
 4  y= 10  //m
 5  Fb= 2  //KN
 6  Fbc= 4  //KN
 7  Rbc= 2
 8  //CALCULATIONS
 9  MFbc= -Fbc*x1*x2^2/(x1+x2)^2
10  MFcb= Fbc*x2*x1^2/(x1+x2)^2
11  DFba= (4/y)/((4/y)+(4*Rbc/(x1+x2)))
12  DFbc= 1-DFba
13  //RESULTS
14  printf("DFba = %.2f",DFba)
15  printf("DFbc = %.2f",DFbc)
```

Scilab code Exa 16.23 chapter 16 example 23

```
 1  //CLC
```

```
 2  x1= 6  //m
 3  x2= 4.5  //m
 4  y1= 3  //m
 5  y2= 3  //m
 6  Fba= 40  //KN
 7  Fbc= 20  //KNm
 8  //CALCULATIONS
 9  MFba= -Fba*(y1+y2)/8
10  MFbc= Fbc*x1^2/12
11  x= sqrt(x1^2+x2^2)
12  DFba= (4/(y1+y2))/((4/(y1+y2))+(4/(x1)))
13  DFbc= 1-DFba
14  DFcb= (4/x1)/((4/x1)+(3/x))
15  DFcd= 1-DFcb
16  //RESULTS
17  printf("DFba = %.2f",DFba)
18  printf("DFbc = %.2f",DFbc)
19  printf("DFcb = %.3f",DFcb)
20  printf("DFcd = %.3f",DFcd)
```

Chapter 18

Plastic Analysis of Beams and Frames

Scilab code Exa 18.1 chapter 18 example 1

```
1  clc
2  //initialisation of variables
3  sigmay= 100 //N/mm^2
4  b= 10 //mm
5  d= 12 //mm
6  //CALCULATIONS
7  My= sigmay*b*d^3*2/(d*12)
8  Mp= sigmay*b*(d/2)*(d/2)
9  f= Mp/My
10 //RESULTS
11 printf ('f= %.1f',f)
```

Scilab code Exa 18.2 chapter 18 example 2

```
1  clc
2  //initialisation of variables
```

```
3  d= 300  //mm
4  b= 150  //mm
5  tw= 8  //mm
6  tf= 12  //mm
7  //CALCULATIONS
8  Zp= b*tf*(d-tf)+(tw*((d-2*tf)^2))/4
9  Ze= (2/d)*((b*d^3)/12-((b-tw)*(d-2*tf)^3)/12)
10  f= Zp/Ze
11  //RESULTS
12  printf ('f= %.2f',f)
```

Scilab code Exa 18.3 chapter 18 example 3

```
1  clc
2  //initialisation of variables
3  d= 200  //mm
4  b= 150  //mm
5  tw= 7  //mm
6  tf= 10  //mm
7  //CALCULATIONS
8  ye= (b*tf*(tf/2)+(d-tf)*tw*((d+tf)/2))/(b*tf+(d-tf)*
       tw)
9  I= ((b*ye^3)/3)-(b-tw)*(((ye-tf)^3)/3)+(tw*((d-ye)
       ^3)/3)
10  Ze= I/(d-ye)
11  yp= (b*tf+(d-tf)*tw)/(2*b)
12  Zp= b*yp*yp/2+b*(tf-yp)*(tf-yp)/2+(d-tf)*tw*((d-tf)
       /2+(tf-yp))
13  f= Zp/Ze
14  //RESULTS
15  printf ('fie= %.2f',f)
```

Scilab code Exa 18.7 chapter 18 example 7

65

```
1  clc
2  //initialisation of variables
3  Load= 100 //KN
4  Length= 10 //m
5  yieldstress= 300 //N/mm^2
6  loadfactor= 1.5
7  //CALCULATIONS
8  requiredultimateload= loadfactor*Load
9  Mp= requiredultimateload*Length/6
10 Zp= Mp/yieldstress
11 //RESULTS
12 printf ('Zp= %.1e mm^3',Zp)
13 disp("The appropriate beam for this is 406*140*49")
```

Chapter 20

Influenece Lines

Scilab code Exa 20.1 chapter 20 example 1

```scilab
1  clc
2  //initialisation of variables
3  Xac= 2 //m
4  Xcb= 4 //m
5  Xbd= 2 //m
6  Wa= 1 //N
7  Wc= 1 //N
8  Wd= 1 //N
9  //CALCULATIONS
10 Rb= Wa*Xac/(Xac+Xcb)
11 Sc= Rb
12 Ra= Wc*Xcb/(Xac+Xcb)
13 Sc1= -Ra
14 Ra1=-Wd*Xbd/(Xac+Xcb)
15 Mc= Ra*Xac
16 Mc1= Ra1*Xac
17 //RESULTS
18 printf ('Rb= %.2 f KN',Rb)
19 printf (' \n Ra= %.2 f KN ',Ra)
20 printf (' \n Ra= %.2 f KN ',Ra1)
21 printf (' \n Mc= %.2 f KN m',Mc1)
```

Scilab code Exa 20.2 chapter 20 example 2

```
1  clc
2  // initialisation of variables
3  xac= 2  //m
4  xcb= 4  //m
5  xbd= 2  //m
6  //CALCULATIONS
7  C1e= xac/((xac)+(xcb))
8  C1f= xcb/ ((xac)+(xcb))
9  C2h= 1/((1/xac)+(1/xcb))
10 //RESULTS
11 printf ('C1e= %.2f m',C1e)
12 printf (' \n C1f= %.2f m',C1f)
13 printf (' \n C2h= %.2f m',C2h)
```

Scilab code Exa 20.3 chapter 20 example 3

```
1  clc
2  // initialisation of variables
3  W1= 3  //KN
4  W2= 4  //KN
5  W3= 5  //KN
6  x1= 0.3  //m
7  x2= 0.1  //m
8  x3= 0.5  //m
9  x4= 0.7  //m
10 //CALCULATIONS
11 Skmax= W3*x1+W2*x2
12 Sk1= W1*(-x4)+W2*(-x3)+W3*(-x1)
13 Sk2= W1*(x2)+W2*(-x4)+W3*(-x3)
```

```
14  //RESULTS
15  printf ('Sk(max)= %.2 f KN',Skmax)
16  printf (' \n Sk= %.2 f KN',Sk1)
17  printf (' \n Sk= %.2 f KN',Sk2)
```

Scilab code Exa 20.4 chapter 20 example 4

```
1  clc
2  //initialisation of variables
3  W= 2 //KN/m
4  l= 2 //m
5  x1= 0.05
6  x2= 0.25
7  x3= 0.75
8  x4= 0.55
9  x5= 1.5
10 x6= 1.875
11 l1= 0.5 //m
12 l2= 1.5 //m
13 //CALCULATIONS
14 Sk= W*l*(1/2)*(x1+x2)
15 Sk1= -W*l*(1/2)*(x3+x4)
16 Mk= W*((1/2)*(x5+x6)*l1+(1/2)*(x5+x6)*l2)
17 //RESULTS
18 printf ('Sk(max +)= %.2 f KN',Sk)
19 printf (' \n Sk(max -)= %.2 f KN',Sk1)
20 printf (' \n Mk(max)= %.2 f KN m',Mk)
```

Scilab code Exa 20.6 chapter 20 example 6

```
1  clc
2  //initialisation of variables
3  W1= 9 //KN
```

```
4  W2= 15 //KN
5  W3= 15 //KN
6  W4= 8 //KN
7  W5= 8 //KN
8  x1= 2 //m
9  x2= 2.3 //m
10 x3= 2.7 //m
11 x4= 2.3 //m
12 l= 20 //m
13 l1= 10.105 //m
14 //CALCULATIONS
15 x= (W2*x1+W3*(x1+x2)+W4*(x1+x2+x3)+W5*(x1+x2+x3+x4))
      /(W1+W2+W3+W4)
16 Ra= (W1+W2+W3+W4+W5)*l1/l
17 Mk= ((W1+W2+W3+W4+W5)/l)*l1*l1-W1*(x1+x2)-W2*x2
18 //RESULTS
19 printf ('Ra= %.1f KN',Ra)
20 printf (' \n Mk= %.1f KN',Mk)
```

Scilab code Exa 20.7 chapter 20 example 7

```
1  clc
2  //initialisation of variables
3  W= 2.5 //KN/m
4  n= 8
5  x= 1.4 //m
6  y= 1.4 //m
7  l= 4 //m
8  x1= 2.5
9  x2= 3.2
10 x3= 0.25
11 x4= 0.3125
12 x5= 0.625
13 x6= 0.5
14 x7= 3.5
```

```
15  a= 45 //degrees
16  //CALCULATIONS
17  Fec= x1*x2*x3*(1/2)/sind(a)
18  Scd= W*(0.5*(x4+x5)*x6+0.5*(x5+x4)*x7)
19  Fec1= Scd/sind(a)
20  //RESULTS
21  printf ('Maximum compressive force= %.2f KN',Fec)
22  printf (' \n Maximum tensile force= %.2f KN',Fec1)
```

Scilab code Exa 20.8 chapter 20 example 8

```
 1  clc
 2  //initialisation of variables
 3  W= 1.5 //KN/m
 4  W1= 1 //KN/m
 5  n=10
 6  x= 0.9 //m
 7  y= 1.2 //m
 8  x1= 5
 9  x2= 0.5
10  x3= 4
11  x4= 0.4
12  x5= 6
13  x6= 0.6
14  x7= 3
15  x8= 0.3
16  //CALCULATIONS
17  S5= -1*0.5*x1*x2+2.5*0.5*x3*x4
18  S51= -1*0.5*x5*x6+2.5*0.5*x7*x8
19  //RESULTS
20  printf ('S5= %.2f KN',S5)
21  printf (' \n S4= %.2f KN',S51)
```