Scilab Textbook Companion for Statics And Strength Of Materials by I. J. Levinson[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

16 Columns **78**

List of Scilab Codes

Chapter 1

Introduction

Scilab code Exa 1.1 chapter 1 example 1

```
clc
//initialisation of variables
L= 20 //ft
angle= 30 //degrees
//CALCULATIONS
d= L*sind(angle)
//RESULTS
printf ('Desitance from foot of Ladder= %.2f ft',d)
```

Scilab code Exa 1.2 chapter 1 example 2

```
clc
//initialisation of variables
a= 5
b= 12
angle= 60 //degrees
//CALCULATIONS
c= sqrt(a^2+b^2-2*a*b*cosd(angle))
```

```
8 //RESULTS
9 printf ('c = %.1f ',c)
```

Scilab code Exa 1.3 chapter 1 example 3

```
1 clc
2 //initialisation of variables
3 a= 5
4 b= 12
5 angle= 120 //degrees
6 //CALCULATIONS
7 c= sqrt(a^2+b^2-2*a*b*cosd(angle))
8 //RESULTS
9 printf ('c = %.1f ',c)
```

Scilab code Exa 1.4 chapter 1 example 4

```
1 clc
2 //initialisation of variables
3 b= 12
4 angle1= 35 //degrees
5 angle2= 43 //degrees
6 //CALCULATIONS
7 angle3= 180-angle1-angle2
8 a= sind(angle2)*b/sind(angle3)
9 c= a*sind(angle1)/sind(angle2)
10 //RESULTS
11 printf ('c = %.2f ',c)
12 printf (' \a=%.2f.',a)
```

Scilab code Exa 1.5 chapter 1 example 5

```
clc
//initialisation of variables
Wofaninch= 0.29 //lb
L= 3.5 //ft
width= 1.75 //ft
t= 1 //in
//CALCULATIONS
W= L*width*t*12*12*Wofaninch
//RESULTS
printf ('W = %.f lb',W)
```

Scilab code Exa 1.6 chapter 1 example 6

```
clc
//initialisation of variables
V= 30 //mph
//CALCULATIONS
Vinfps= V*5280*(1/60)*(1/60)
//RESULTS
printf ('v = %.f fps',Vinfps)
```

Chapter 2

Force Systems Components Resultants Equivalence

Scilab code Exa 2.3 chapter 2 example 3

```
clc
//initialisation of variables
f1= 20 //lb
f2= 40 //lb
alpha= 30 //degrees
//CALCULATIONS
R= sqrt(f1^2+f2^2+2*f1*f2*cosd(alpha))
angle= asind((f2*sind(180-alpha))/(R))
//RESULTS
printf ('R = %.1f lb',R)
printf (' \angle=%.1f degrees',angle)
```

Scilab code Exa 2.4 chapter 2 example 4

```
clc
//initialisation of variables
```

```
fx= 100 //lb
f1= 200 //lb
f2= 100 //lb
f3= 50 //lb
a1= 30 //degrees
a2= 45 //degrees
a3= 60 //degrees
//CALCULATIONS
Rx= fx+f1*cosd(a1)-f2*cosd(a2)-f3*cosd(a3)
Ry= f1*sind(a1)+f2*sind(a2)-f3*sind(a3)
R= sqrt(Rx^2+Ry^2)
angle= atand(Ry/Rx)
//RESULTS
printf ('R = %.f ',R)
printf (' \angle=%.1f degrees',angle)
```

Scilab code Exa 2.5 chapter 2 example 5

```
clc
//initialisation of variables
f1= 100 //lb
f2= 200 //lb
x1= 2
x2= -3
y1= 3
y2= 5
z1= 4
z2= -2
//CALCULATIONS
d1= sqrt(x1^2+y1^2+z1^2)
d2= sqrt(x2^2+y2^2+z2^2)
f1x= f1*x1/d1
f1y= f1*y1/d1
f1z= f1*z1/d1
f2x= f2*x2/d2
```

```
f2y= f2*y2/d2
f2z= f2*z2/d2
Rx= f1x+f2x
Ry= f1y+f2y
Rz= f1z+f2z
R= sqrt(Rx^2+Ry^2+Rz^3)
I1= Rx/R
I2= Ry/R
I3= Rz/R
//RESULTS
printf ('R = %.2f lb',R)
printf (' \I1=%.3f ',I1)
printf (' \I2=%.3f ',I2)
printf (' \I3=%.3f ',I3)
```

Scilab code Exa 2.6 chapter 2 example 6

```
clc
//initialisation of variables
F= 100 //lb
x1= 6 //in
x2= 8 //in
x3= 2 //in
//CALCULATIONS
xab= sqrt(x1^2+x2^2)
d= x3*x1/xab
M1= F*d
Fx= F*x2/xab
Fy= F*x1/xab
M2= Fy*xab-Fx*x1
M3= Fy*x3
//RESULTS
printf ('M1 = %.f lb.in',M1)
printf (' \M2=%.f lb.in',M2)
printf (' \M3=%.f lb.in',M3)
```

Scilab code Exa 2.7 chapter 2 example 7

```
clc
//initialisation of variables
Fy1= 2 //kips
Fy2= 5 //kips
Fy3= 10 //kips
Fy4= 3 //kips
L= 5 //ft
Ry= Fy1+Fy2+Fy3+Fy4
x= (Fy1*L+Fy2*2*L+Fy3*3*L+Fy4*4*L)/Ry
//RESULTS
printf ('Ry= %.2f kips',Ry)
printf (' \n x=%.1f ft to the right of O',x)
```

Scilab code Exa 2.8 chapter 2 example 8

```
clc
//initialisation of variables
Fx1= -15 //lb
Fx2= 55 //lb
Fy1= 70 //lb
Fy2= -40 //lb
x1= 4 //in
x2= 3 //in
x3= 5 //in
y1= 4 //in
y2= 2 //in
//CALCULATIONS
Rx= Fx1+Fx2
Ry= Fy1+Fy2
```

```
15 R= sqrt(Rx^2+Ry^2)
16 angle= atand(Ry/Rx)
17 //RESULTS
18 printf ('R= %.2f lb',R)
19 printf ('\n angle=%.1f degrees',angle)
```

Scilab code Exa 2.9 chapter 2 example 9

```
1 clc
2 //initialisation of variables
3 Fy= 200 //lb
4 Fx= 100 //lb
5 y= 3 //in
6 x= 6 //in
7 //CALCULATIONS
8 M= Fy*x-Fx*y
9 //RESULTS
10 printf ('Moment= %.2f lb in',M)
```

Chapter 3

Center of Gravity

Scilab code Exa 3.1 chapter 3 example 1

```
clc
//initialisation of variables
W= 3000 //lb
L= 10 //ft
Wf1= 1200 //lb
Wf2= 1500 //lb
angle= 30 //degrees
//CALCULATIONS
d1= Wf1*cosd(angle)*L/W
d2= Wf2*L/W
xbc= d1/cosd(angle)
xab= d2-xbc
y= xab/tand(angle)
//RESULTS
printf ('x = %.2f ft',d2)
printf ('\n y=%.1f ft',y)
```

Scilab code Exa 3.2 chapter 3 example 2

```
clc
//initialisation of variables
W4= 3 //lb
W3= 5 //lb
W2= 2 //lb
W1= 6 //lb
x1= 10 //in
x2= 4 //in
z= 5 //in
//CALCULATIONS
W= W1+W2+W3+W4
x= (W1*0+W2*0+W3*x2+W4*x1)/W
z= (W1*z+W2*0+W3*0+W4*0)/W
//RESULTS
printf ('x = %.2f in',x)
printf ('\n z=%.2f in',z)
```

Scilab code Exa 3.3 chapter 3 example 3

```
clc
//initialisation of variables
W1= 3 //lb
W2= 5 //lb
x1= 8 //in
x2= 7 //in
y1= 2 //in
y2= 5 //in
z1= 6 //in
z2= 4 //in
//CALCULATIONS
W= W1+W2
x= (W1*x1+W2*x2)/W
y= (W1*y1+W2*y2)/W
z= (W1*z1+W2*z2)/W
//RESULTS
```

```
17 printf ('x = %.2f in',x)
18 printf ('\n y=%.2f in',y)
19 printf ('\n z=%.2f in',z)
```

Scilab code Exa 3.4 chapter 3 example 4

```
1 clc
2 //initialisation of variables
3 L= 9 //in
4 B= 16 //in
5 B1= 6 //in
6 d= 2 //in
7 //CALCULATIONS
8 x= ((L*(B-B1)*(L/2)+(1/2)*L*B1*(L/3)-(%pi/4)*d^2*(L
    /2)))/(L*(B-B1)+(1/2)*L*B1-(%pi/4)*d^2)
9 y=  ((L*(B-B1)*((B-B1)/2)+(1/2)*L*B1*(B1/3+(B-B1))-(
    %pi/4)*d^2*((B-B1)/2)))/(L*(B-B1)+(1/2)*L*B1-(%pi
    /4)*d^2)
10 //RESULTS
11 printf ('x = %.2f in to the right of y-axis',x)
12 printf ('\n y=%.2f in above x axis',y)
```

Scilab code Exa 3.5 chapter 3 example 5

```
1 clc
2 //initialisation of variables
3 Gt= 0.25 //in
4 St= 0.25 //in
5 Gw= 3.5 //lb/sq ft
6 Sw= 10 //lb/sq ft
7 Sb= 36 //in
8 Sb1= 18 //in
9 Sb2= 12 //in
```

```
Sb3= 6 //in
Sy1= 6 //in
Sy2= 12 //in
Sy3= 6 //in
Gb= 1 //ft
Sh= 24 //in
Gh= 1 //ft
//CALCULATIONS
W= ((Sb*Sh)/(12*12)-(Gh*Gb))*Sw+(Gh*Gb)*Gw
x= ((Sb*Sh)*Sw*(Sb/24)/(12*12)-(Gh*Gb)*Sw*((Sb1+(Sb2
   /2))/12)+(Gh*Gb)*Gw*((Sb1+(Sb2/2))/12))/W
//RESULTS
printf ('centre of gravity = %.2f ft to the right of
    y-axis',x)
```

Chapter 4

Equilibrium

Scilab code Exa 4.3 chapter 4 example 3

```
clc
//initialisation of variables
W= 100 //lb
a1= 30 //degrees
a2= 45 //degrees
//CALCULATIONS
A=[(cosd(a2)),(-cosd(a1));(sind(a2)),(sind(a1))]
b=[0;W]
c= A\b
Tbc= c(1,1)
Tab= c(2,1)
//RESULTS
printf ('Tbc= %.1f lb',Tbc)
printf ('\n Tab=%.1f lb',Tab)
```

Scilab code Exa 4.4 chapter 4 example 4

```
clc
```

```
2 //initialisation of variables
3 W1= 7000 //lb
4 W2= 1000 //lb
5 W3= 3000 //lb
6 x1= 6 //in
7 x2= 9 //in
8 x3= 10 //in
9 x4= 5 //in
10 //CALCULATIONS
11 Rb= (W1*x1+W2*(x1+x2)+W3*(x1+x2+x3))/(x1+x2+x3+x4)
12 Ra= W1+W2+W3-Rb
13 //RESULTS
14 printf ('Rb= %.1f lb',Rb)
15 printf ('\n Ra=%.1f lb',Ra)
```

Scilab code Exa 4.5 chapter 4 example 5

```
1 clc
2 //initialisation of variables
3 Fc= 500 //lb
4 Fd= 1000 //lb
5 xc= 2 //in
6 xd= 8 //in
7 y= 6 //in
8 //CALCULATIONS
9 Ay= Fc+Fd
10 Bx= (Fc*xc+Fd*xd)/y
11 Ax= Bx
12 A= sqrt(Ax^2+Ay^2)
13 //RESULTS
14 printf ('A= %.f lb',A)
15 printf ('\n B=%.f lb',Bx)
```

Scilab code Exa 4.6 chapter 4 example 6

```
clc
//initialisation of variables
W= -300 //lb
r= 4 //in
x1= 2 //ft
x2= 3 //ft
x3= 1 //ft
y1= 1 //ft
x4= 3 //in
//CALCULATIONS
F= -W*r/(y1*12)
By= -W*x1/(x1+x2)
Bz= -F*(x1+x2+x3+(x4/12))/(x1+x2)
Ay= -W-By
Az= -F-Bz
//RESULTS
printf ('Ay = %.2f lb',Ay)
printf ('\n By=%.2f lb',By)
printf ('\n Az=%.2f lb',Az)
printf ('\n Bz=%.2f lb',Bz)
printf ('\n F=%.2f lb',F)
```

Scilab code Exa 4.7 chapter 4 example 7

```
clc
//initialisation of variables
W= 500 //lb
r= 4 //in
Lx= 3 //in
Ly= 12 //in
Lz= 4 //in
//CALCULATIONS
Tbd= W*(sqrt((-Lx)^2+(-Ly)^2+(-Lz)^2))/Ly
```

```
10 Tcd= Lx*Tbd/(sqrt((-Lx)^2+(-Ly)^2+(-Lz)^2))
11 Tad= Lz*Tbd/(sqrt((-Lx)^2+(-Ly)^2+(-Lz)^2))
12 //RESULTS
13 printf ('Tbd= %.f lb',Tbd)
14 printf (' \n Tcd=%.f lb',Tcd)
15 printf (' \n Tad=%.f lb',Tad)
```

Chapter 5

Force Analysis of Structures

Scilab code Exa 5.1 chapter 5 example 1

```
1  clc
2  //initialisation of variables
3  Fc= -1000 //lb
4  A= 60 //degrees
5  E1= 60 //degrees
6  E2= 60 //degrees
7  D= 60 //degrees
8  L1= 10 //ft
9  L2= 10 //ft
10 //CALCULATIONS
11 Ax= 0
12 Ay= (-Fc)*L1*cosd(D)/(L1+L2)
13 Dy= -Fc-Ay
14 Fab= Ay/sind(A)
15 Fae= Fab*cosd(A)
16 Fbe= Fab*cosd(90-E1)/cosd(90-A)
17 Fbc= Fab*sind(90-A)+Fbe*sind(90-E1)
18 Fce= Fbc*cosd(90-(180-E2-D))/cosd(90-E2)
19 Fde= Fae+Fbe*cosd(E1)+Fce*cosd(E2)
20 Fcd= (-Fc-Fbc*cosd(90-E2-D))/cosd(90-E)
21 //RESULTS
```

```
22 printf ('Ax= %.3f lb',Ax)
23 printf ('\n Ay=%.2f lb',Ay)
24 printf ('\n Dy=%.3f lb',Dy)
25 printf ('\n Fab=%.2f lb(compression)',Fab)
26 printf ('\n Fae=%.2f lb(tension)',Fae)
27 printf ('\n Fbe=%.2f lb(tension)',Fbe)
28 printf ('\n Fbc=%.2f lb(compression)',Fbc)
29 printf ('\n Fce=%.2f lb(compression)',Fce)
30 printf ('\n Fde=%.2f lb(tension)',Fde)
31 printf ('\n Fcd=%.2f lb(compression)',Fcd)
```

Scilab code Exa 5.2 chapter 5 example 2

```
1  clc
2  //initialisation of variables
3  W= -100 //lb
4  angle= 45 //degrees
5  x1= 2 //ft
6  x2= 2 //ft
7  y1= 2 //ft
8  y2= 4 //ft
9  Fx= 200 //lb
10 //CALCULATIONS
11 Cx= Fx*y1/y2
12 Bx= Fx+Cx
13 By= (y2*Bx+x1*(-W))/(x1+x2)
14 Cy= By
15 Ax= Bx
16 Ay= W+By
17 //RESULTS
18 printf ('Ax= %.3f lb',Ax)
19 printf ('\n Ay=%.2f lb',Ay)
20 printf ('\n Bx=%.3f lb',Bx)
21 printf ('\n By=%.2f lb',By)
22 printf ('\n Cx=%.2f lb',Cx)
```

```
23 printf ('\n Cy=%.2f lb',Cy)
```

Chapter 6

Friction

Scilab code Exa 6.1 chapter 6 example 1

```
1 clc
2 //initialisation of variables
3 W= 100 //lb
4 Frictioncoefficient= 0.65
5 //CALCULATIONS
6 A1= atand(Frictioncoefficient)
7 //RESULTS
8 printf ('Maximum Incliantion= %.f degrees',A1)
```

Scilab code Exa 6.2 chapter 6 example 2

```
1 clc
2 //initialisation of variables
3 W= 100 //lb
4 Frictioncoefficient= 0.40
5 x= 3
6 y= 4
7 //CALCULATIONS
```

```
8  Fmax= (W*y/(sqrt(x^2+y^2)))+Frictioncoefficient*W*x
      /(sqrt(x^2+y^2))
9  Fmin=(W*y/(sqrt(x^2+y^2)))-Frictioncoefficient*W*x/(
      sqrt(x^2+y^2))
10  //RESULTS
11 printf ('Fmin= %.f lb',Fmin)
12 printf (' \n Fmax=%.f lb',Fmax)
```

Scilab code Exa 6.3 chapter 6 example 3

```
1  clc
2  //initialisation of variables
3  mus= 0.25
4  d= 0.5 //in
5  h= 3 //in
6  //CALCULATIONS
7  A=[1 -1;mus mus]
8  b= [0;1]
9  c= A\b
10 Na= c(1,1)
11 Nb= c(2,1)
12 d= -d*mus*Na+h*Na
13 //RESULTS
14 printf ('minimu distance= %.2f in',d)
```

Scilab code Exa 6.4 chapter 6 example 4

```
1  clc
2  //initialisation of variables
3  Ft= 1000 //lb
4  a1= 5 //degrees
5  mu= 0.30
6  //CALCULATIONS
```

```
7 R1= Ft/cosd(a1+atand(mu))
8 F= R1*sind(a1+atand(mu)+atand(mu))/sind(90-atand(mu)
    )
9 //RESULTS
10 printf ('Forec required to start wedge= %.f lb',F)
```

Scilab code Exa 6.5 chapter 6 example 5

```
1 clc
2 //initialisation of variables
3 W= 100 //lb
4 n1= 1/2
5 n2= 3/2
6 mus= 0.40
7 //CALCULATIONS
8 Ts1= W/(exp(mus*n1*2*%pi))
9 Ts2=  W/(exp(mus*n2*2*%pi))
10 //RESULTS
11 printf ('Ts1= %.2f lb',Ts1)
12 printf (' \n Ts2=%.2f lb',Ts2)
```

Scilab code Exa 6.6 chapter 6 example 6

```
1 clc
2 //initialisation of variables
3 F= 20//lb
4 L1= 6 //in
5 L2= 12 //in
6 L3= 24 //in
7 mus= 0.60
8 //CALCULATIONS
9 A=[(1),(-exp(mus*%pi));(L1+L2),(L1)]
10 b=[0;F*(L1+L2+L3)]
```

```
11 c= A\b
12 TL= c(1,1)
13 Ts= c(2,1)
14 //RESULTS
15 printf ('TL= %.2f lb',TL)
16 printf ('\n Ts=%.2f lb',Ts)
```

Scilab code Exa 6.7 chapter 6 example 7

```
1 clc
2 //initialisation of variables
3 d= 24 //in
4 mu= 0.05
5 W= 2000 //lb
6 //CALCULATIONS
7 F= W*mu*2/d
8 //RESULTS
9 printf ('F= %.2f lb',F)
```

Scilab code Exa 6.8 chapter 6 example 8

```
1 clc
2 //initialisation of variables
3 F= 800 //lb
4 muk= 0.10
5 Do= 5 //in
6 Di= 3 //in
7 //CALCULATIONS
8 M= 2*muk*F*((Do/2)^3-(Di/2)^3)/(3*((Do/2)^2-(Di/2)
    ^2))
9 //RESULTS
10 printf ('M= %.f lb in',M)
```

Chapter 7

Moment of Inertia

Scilab code Exa 7.1 chapter 7 example 1

```
clc
//initialisation of variables
x1= 3 //in
x2= 3 //in
x3= 3 //in
x4= 3 //in
x5= 5 //in
x6= 5 //in
x7= 5 //in
x8= 5 //in
L1= 1 //in
L2= 1 //in
L3= 1 //in
L4= 1 //in
L5= 1 //in
L6= 1 //in
L7= 1 //in
L8= 1 //in
y= 7.5 //in
//CALCULATIONS
Ix1= x1*L1*(y)^2
```

```
Ix2= x2*L2*(y-L2)^2
Ix3= x3*L3*(y-L3-L2)^2
Ix4= x4*L4*(y-L4-L3-L2)^2
Ix5= x5*L5*(y-L5-L4-L3-L2)^2
Ix6= x6*L6*(y-L6-L5-L4-L3-L2)^2
Ix7= x7*L7*(y-L7-L6-L5-L4-L3-L2)^2
Ix8= x8*L8*(y-L8-L7-L6-L5-L4-L3-L2)^2
Ix= Ix1+Ix2+Ix3+Ix4+Ix5+Ix6+Ix7+Ix8
//RESULTS
printf ('Ix= %.f in^4',Ix)
```

Scilab code Exa 7.2 chapter 7 example 2

```
clc
//initialisation of variables
Iy= 60 //in^4
A= 25 //sq in
x= 10 //in
//CALCULATIONS
Ia= Iy+ A*x^2
//RESULTS
printf ('I= %.f in^4',Ia)
```

Scilab code Exa 7.3 chapter 7 example 3

```
clc
//initialisation of variables
L= 5 //in
B= 12 //in
Ix= 227 //in^4
Iy= 10 //in^4
A= 10.2 //sq in
//CALCULATIONS
```

```
Kx= sqrt(Ix/A)
Ky= sqrt(Iy/A)
//RESULTS
printf ('Radius of gyration wrt x= %.2f in',Kx)
printf (' \n Radius of gyration wrt y=%.2f in',Ky)
```

Scilab code Exa 7.4 chapter 7 example 4

```
clc
//initialisation of variables
L1= 8 //in
B1= 1 //in
L2= 1 //in
B2= 6 //in
L3= 8 //in
B3= 1 //in
//CALCULATIONS
Iy= (B1*L1^3/12)+(B2*L2^3/12)+(B3*L3^3/12)
Ix= (L1*B1^3/12)+L1*B1*((B2/2)+(B1/2))^2+(L2*B2
   ^3/12)+(L3*B3^3/12)+L3*B3*((B2/2)+(B3/2))^2
//RESULTS
printf ('Ix= %.2f in^4',Ix)
printf (' \n Iy=%.2f in^4',Iy)
```

Scilab code Exa 7.5 chapter 7 example 5

```
clc
//initialisation of variables
H= 8 //in
b= 6 //in
d= 4 //in
H1= 5 //in
//CALCULATIONS
```

```
Ia1= ((b*H^3)/12)+b*H*d^2
Ia2= %pi*((d/2)^2)+%pi*((d/2)^2)*(H1)^2
I= Ia1-Ia2
//RESULTS
printf ('I= %.2f in^4',I)
```

Scilab code Exa 7.6 chapter 7 example 6

```
clc
//initialisation of variables
W= 64.4 //lb
I= 10 //slugft^2
g= 32.2 //ft/sec^2
//CALCULATIONS
m= W/g
k= sqrt(I/m)
//RESULTS
printf ('k= %.2f ft',k)
```

Scilab code Exa 7.8 chapter 7 example 8

```
clc
//initialisation of variables
d1= 18 //in
d2= 10 //in
d3= 4 //in
Wpercuin= 0.31 //lb
L1= 4 //in
L2= 8 //in
g= 32.2 //ft/sec^2
//CALCULATIONS
m1= %pi*(d1/2)^2*L1*Wpercuin/g
I1= m1*(d1/24)^2/2
```

```
13 m2= %pi*(d2/2)^2*L2*Wpercuin/g
14 I2= m2*(d2/24)^2/2
15 m3= %pi*(d3/2^2)*(L1+L2)*Wpercuin/g
16 I3= m3*(d3/24)^2/2
17 I= I1+I2-I3
18 //RESULTS
19 printf ('I= %.2f slug ft^2',I)
```

Chapter 8

Concept of Stress

Scilab code Exa 8.1 chapter 8 example 1

```
clc
//initialisation of variables
F= -100 //lb
x1= 3 //in
y= 6 //in
x2= 24 //in
x3= 12 //in
//CALCULATIONS
Force= -F
Moment= -F*(x2+x1)
Torque= -F*y
//RESULTS
printf ('Force= %.2f lb',Force)
printf ('\n Moment=%.2f lb.in',Moment)
printf ('\n Torque=%.2f lb.in',Torque)
```

Scilab code Exa 8.2 chapter 8 example 2

```
clc
//initialisation of variables
F= -5000 //lb
D= 250 //lb/ft
y1= 4 //in
y2= 2 //in
y3= 5 //in
y4= 3 //in
x= 3 //in
//CALCULATIONS
Ax= -D*y1
Ay= -F
M= (D*y1*(y2+y3+y1/2))-F*x
//RESULTS
printf ('Ax= %.2f lb',Ax)
printf ('\n Ay=%.2f lb',Ay)
printf ('\n M=%.2f lb.in',M)
```

Scilab code Exa 8.3 chapter 8 example 3

```
clc
//initialisation of variables
P= 5 //kips
angle= 30 //degrees
//CALCULATIONS
Fn= P*sind(angle)
Ft= P*cosd(angle)
//RESULTS
printf ('Fn= %.2f lb',Fn)
printf ('\n Ft=%.2f lb',Ft)
```

Scilab code Exa 8.4 chapter 8 example 4

```
clc
//initialisation of variables
p= 5 //tons
dt= 0.75 //in
db= 0.5 //in
b= 0.5 //in
h= 2 //in
//CALCULATIONS
Sc= p*2000/((%pi/4)*(dt^2))
Sr=  p*2000/(b*h)
Sb=  p*2000/(2*(%pi/4)*db^2)
//RESULTS
printf ('Stress in circular scetion= %.2f psi
   tension',Sc)
printf ('\n Stress in rectangular section=%.2f psi
   tension',Sr)
printf ('\n Stress in bolt=%.2f psi tension',Sb)
```

Scilab code Exa 8.5 chapter 8 example 5

```
clc
//initialisation of variables
w= 8 //in
wperft= 35 //lb/ft
A= 10.3 //sq in
F1= 3 //tons
F2= 3 //tons
F3= -8 //tons
F4= -8 //tons
F5= -5 //tons
F6= -5 //tons
Pl= 12 //in
Pb= 12 //in
//CALCULATIONS
Sa= (F1+F2)*2000/A
```

```
Sb= -(F3+F4+F1+F2)*2000/A
Sc= -(F3+F4+F1+F2+F5+F6)*2000/A
Sp= -(F3+F4+F1+F2+F5+F6)*2000/(Pl*Pb)
//RESULTS
printf ('Stress in a= %.2f psi tension',Sa)
printf (' \n Stress in b=%.2f psi tension',Sb)
printf (' \n Stress in c=%.2f psi tension',Sc)
printf (' \n Stress in plate=%.2f psi tension',Sp)
```

Scilab code Exa 8.6 chapter 8 example 6

```
clc
//initialisation of variables
Ns= 8000 //psi
Ss= 4000 //psi
Ws= 25000 //psi
angle= 30 //degrees
L= 4 //in
b= 1 //in
//CALCULATIONS
P= Ns*L*b/((cosd(2*angle))^2)
P1= 2*Ss*L*b/(sind(2*angle))
Pts= Ws*L*b
e= P1/Pts
//RESULTS
if (P<P1)
    printf ('P= %.2f lb',P)
else
    printf ('P1= %.2f lb',P1)
end
printf (' \n efficiency of the joint=%.2f ',e)
```

Scilab code Exa 8.7 chapter 8 example 7

```
clc
//initialisation of variables
T= 15000 //psi
h1= 3 //in
h2= 2.5 //in
t= 0.25 //in
r= 5/16 //in
d= 1 //in
//CALCULATIONS
P1= T*(h1-d)*t/2.18
P2= T*h2*t/1.7
if (P1<P2)
    printf ('Safe axial load= %.2f lb',P1)
else
    printf ('Safe axial load= %.f lb',P2)

end
```

Scilab code Exa 8.8 chapter 8 example 8

```
clc
//initialisation of variables
d= 16 //ft
h= 24 //ft
P= 160 //lb/cu ft
hs1= 8 //ft
hs2= 8 //ft
hs3= 8 //ft
Tsmax= 5000 //psi
//CALCULATIONS
SW= P/1728
P8= SW*hs1*12
P16= SW*(hs1+hs2)*12
P24= SW*(hs1+hs2+hs3)*12
t8= (P8*d*12)/(2*Tsmax)
```

```
16 t16= P16*d*12/(2*Tsmax)
17 t24= P24*d*12/(2*Tsmax)
18 //RESULTS
19 printf ('t8= %.2f in',t8)
20 printf ('\n t16=%.2f in',t16)
21 printf ('\n t24=%.2f in',t24)
```

Chapter 9

Concept of Strain

Scilab code Exa 9.1 chapter 9 example 1

```
clc
length=10 //ft
delta=0.024 //in
epsilon=delta/(length*12)
printf("Axial strain=%f in/in",epsilon)
```

Scilab code Exa 9.2 chapter 9 example 2

```
clc
drop=5 //in
width=8 //ft
deltaMB=sqrt((width*12/2)^2 +drop^2) - (width*12/2)
epsilon=deltaMB/(width*12/2)
printf("Strain in the wire= %f in/in",epsilon)
```

Scilab code Exa 9.4 chapter 9 example 4

```
clc
length=15 //in
tension=5000 //lb
UltStress=20000 //psi
delta=0.005 //in
E=30*10^6 //psi
A1=tension/UltStress
A2=tension*length/(delta*E)
if A1>=A2     then
    A=A1
else
    A=A2
end
Dia=sqrt(4*A/%pi)
printf("diameter required= %f in", Dia)
```

Scilab code Exa 9.5 chapter 9 example 5

```
clc
L1=5
L2=10
T1=2.5
T2=5
T3=5
T4=5
T5=2.5
E=30*10^6  //psi
outDia=2 //in
inDia=1/8 //in
RE=(T1+T2+T3+T4+T5)/2 //kips
RA=RE
disp("From the figure 9.12")
GH=(RA*L2-T2*L1-T1*L2)/4
printf("Stress in GH=%f kips",GH)
A=%pi*(outDia^2-(outDia-2*inDia)^2)/4
```

```
delta=GH*10^3 *(L1*12)/(E*A)
printf("\n Deformation=%f in",delta)
sigma=GH*10^3 /A
printf("\n Stress=%d psi",sigma)
SF=65000/sigma
printf("\n Factor of safety=%f ",SF)
```

Scilab code Exa 9.6 chapter 9 example 6

```
clc
//initialisation of variables
Es= 30*10^6 //psi
As= 1 //in^2
Ea= 10*10^6 //psi
Aa= 2 //in^2
Ls= 10 //ft
La= 5 //ft
//CALCULATIONS
A=[(Ls/(Es*As)) (-La/(Ea*Aa));1 1]
b= [0;1]
c= A\b
Fa= c(1,1)
Fb= c(2,1)
d= Fb*Ls
//RESULTS
printf ('distance= %.2f ft',d)
```

Scilab code Exa 9.7 chapter 9 example 7

```
clc
P=40000 //lb
L=15 //in
delta=0.0032 //in
```

```
dia=4 //in
axial=0.0032  //in
lateral=0.00022  //in
E=P*L/(delta*%pi*(dia/2)^2)
printf("Modulus of elasticity=%f psi",E)
Mu=lateral*L/(axial*dia)
printf("\n Poisson ratio= %f",Mu)
```

Scilab code Exa 9.8 chapter 9 example 8

```
clc
alpha=11.2*10^(-6) //in/in/F
E=15*10^6 //psi
L=60 //in
deltaT1=0.01 //in
T2=50 //F
deltaT=deltaT1/(alpha*L)
printf("The temperature increase necessary to cause
   free end to touch B=%f F",deltaT)
disp("From the geometry of the figure")
sigma=(alpha*L*T2-deltaT1)*E/L
printf("Stress in the rod=%d psi",sigma+1)
```

Scilab code Exa 9.9 chapter 9 example 9

```
clc
weight=25000 //Kg
A=2 //sq.in
alphaS=6.5*10^(-6) //in/in/F
alphaB=11.2*10^(-6) //in/in/F
Es=30*10^6 //psi
Eb=15*10^6 //psi
disp("From the figure, DeltaTs+DeltaPs=DeltaTb")
```

```
9 deltaT=weight/(Es*A*(alphaB-alphaS))
10 printf("Net temperature drop=%f F",deltaT)
```

Scilab code Exa 9.10 chapter 9 example 10

```
1 clc
2 S=5 //in
3 Al=6 //in
4 alphaS=6.5*10^(-6) //in/in/F
5 alphaAl=13.1*10^(-6) //in/in/F
6 Es=30*10^6 //psi
7 EAl=10*10^6 //psi
8 As=1 //in^2
9 AAl=2 //in^2
10 T=50 //F
11 dia=1 //in
12 disp("From the figure, it is evident that DeltaPs+
   DeltaPAl=DeltaTs+DeltaTAl")
13 P=(alphaS*S*12*T + alphaAl*Al*12*T)/(S*12/(Es*As) +
   Al*12/(EAl*AAl))
14 printf("Shearing force= %d lb",P)
15 T=P/(%pi*(dia/2)^2)
16 printf("\n The shear stress in the pin=%d psi",T)
```

Scilab code Exa 9.11 chapter 9 example 11

```
1 clc
2 edge=2 //in
3 height=3 //in
4 F=20000 //lb
5 deltaS=0.00234 //in
6 deltaA=0.00088 //in
7 E=F*height/(deltaA*edge*edge)
```

```
8  printf("Modulus of elasticity=%f psi",E)
9  G=F*height/(deltaS*edge*edge)
10 printf("\n Modulus of Rigidity=%f psi",G)
11 Mu=E/(2*G) -1
12 printf("\n Poisson ratio=%f ",Mu)
```

Chapter 10

Torsion

Scilab code Exa 10.1 chapter 10 example 1

```
clc
//initialisation of variables
L= 50 //ft
Do= 2 //in
Di= 1.5 //in
Mt= 10000 //lb in
G= 12*10^6
//CALCULATIONS
Tmax= 16*Mt*Do/(%pi*(Do^4-Di^4))
angle= (Mt*L*12*32)*57.3/(G*%pi*(Do^4-Di^4))
//RESULTS
printf ('Maximum shearing strees= %.2f psi',Tmax)
printf (' \n twist angle=%.2f degrees',angle)
```

Scilab code Exa 10.2 chapter 10 example 2

```
clc
//initialisation of variables
```

```
d= 4 //ft
T= 5000 //psi
angle= 0.1 //degrees
//CALCULATIONS
T1= (%pi*d^3)*T/16
T2=angle*%pi*G*%pi*d^4/(180*12*32)
//RESULTS
if (T1<T2)
    printf ('Safe torque= %.2f lb in',T1)
else
    printf ('Safe torque= %.2f lb',T2)
end
```

Scilab code Exa 10.3 chapter 10 example 3

```
clc
//initialisation of variables
Ds= 1 //in
Db= 1.5 //in
Ls= 4 //in
Lb= 6 //in
Gs= 12*10^6 //psi
Gb= 6.4*10^6 //psi
T= 10000 //lb in
//CALCULATIONS
A=[(1),(1);(Ls*12/(Gs*Ds^4)),(-Lb*12/(Gb*Db^4))]
b=[T;0]
c= A\b
Tab= c(1,1)
Tbc= c(2,1)
//RESULTS
printf ('Torque in section AB= %.2f lb in',Tab)
printf ('\n Torque in section AB =%.2f lb in',Tbc)
```

Scilab code Exa 10.4 chapter 10 example 4

```
clc
//initialisation of variables
T= 10000 //lb in
G= 12*10^6
Dab= 1.5 //in
Lab= 4 //in
Dcd= 1 //in
Lcd= 3 //in
//CALCULATIONS
F= T/2
Tab= F*Lab
angle= ((T*32*12*Lcd/(G*%pi*Dcd^4))+2*(Tab*32*12*Lab
   /(G*%pi*Dab^4)))*(180/%pi)
//RESULTS
printf ('angle of twist= %.2f degrees',angle)
```

Scilab code Exa 10.5 chapter 10 example 5

```
clc
//initialisation of variables
Tallowable= 5000 //psi
power= 250 //hp
n= 1800 //rpm
//CALCULATIONS
T= 63000*power/n
d= (16*T/(%pi*Tallowable))^(1/3)
//RESULTS
printf ('Torque= %.2f lb in',T)
printf ('\n diameter=%.2f in',d)
```

Scilab code Exa 10.6 chapter 10 example 6

```
clc
//initialisation of variables
ds= 2 //in
n= 315 //rpm
Gs= 12*10^6
Lab= 5 //in
Lbc= 15 //in
Pa= 10 //hp
Pc= 40 //hp
Pb= 50 //hp
//CALCULATIONS
Tab= 63000*Pa/n
Tbc= 63000*Pc/n
angle= ((32*Tbc*Lbc*12/(%pi*ds^4*G))-(32*Tab*Lab
   *12/(%pi*ds^4*G)))*(180/%pi)
//RESULTS
printf ('angle of twist of gear C releative to a= %
   .2f degrees',angle)
```

Scilab code Exa 10.7 chapter 10 example 7

```
clc
//initialisation of variables
k1= 6*10^6 //lb in/rad
k2= 3*10^6 //lb in/rad
k3= 2*10^6 //lb in/rad
T= 10000 //lb in
//CALCULATIONS
ke= 1/((1/k1)+(1/k2)+(1/k3))
angle= T*180/(ke*%pi)
```

```
10 //RESULTS
11 printf ('equivalent spring constant= %.2e lb in/rad'
      ,ke)
12 printf ('\n angle of twist d/a=%.2f degrees',angle)
```

Scilab code Exa 10.8 chapter 10 example 8

```
1 clc
2 //initialisation of variables
3 k1= 2*10^6 //lb in/rad
4 k2= 3*10^6 //lb in/rad
5 T= 20000 //lb in
6 //CALCULATIONS
7 ke= k1+k2
8 angle= T*180/(ke*%pi)
9 //RESULTS
10 printf ('equivalent spring constant= %.2e lb in/rad'
      ,ke)
11 printf ('\n angle of twist at B=%.2f degrees',angle)
```

Scilab code Exa 10.10 chapter 10 example 10

```
1 clc
2 //initialisation of variables
3 di= 0.2 //in
4 dm= 2 //in
5 n= 10
6 F= 10 //lb
7 G= 12*10^6
8 //CALCULATIONS
9 k= G*di^4/(64*dm^3*n)
10 ke= 1/((1/(k+k))+(1/k)+(1/k))
11 delta= F/ke
```

```
12 //RESULTS
13 printf ('elongation= %.2f in',delta)
```

Scilab code Exa 10.11 chapter 10 example 11

```
1  clc
2  //initialisation of variables
3  d= 0.5 //in
4  n= 315 //rpm
5  t1= 5000 //psi
6  r1= 8 //in
7  r2= 4 //in
8  n1= 6
9  n2= 4
10 //CALCULATIONS
11 t2= r2*t1/r1
12 T= r1*n1*(%pi/4)*d^2*t1+r2*n2*(%pi/4)*d^2*t2
13 hp= T*n/63000
14 //RESULTS
15 printf ('Premissible horsepower= %.f hp',hp)
```

Chapter 12

Stresses in Beam

Scilab code Exa 12.1 chapter 12 example 1

```
clc
//initialisation of variables
L= 20 //ft
b1= 12 //in
h1= 4 //in
b2= 4 //in
h2= 12 //in
Fs= 1200 //psi
La= 5 //ft
Lb= 15 //ft
//CALCULATIONS
Ina= b1*h1^3/12
P1= (Fs*Ina*4)/((h1/2)*12*La*3)
Ina1= b2*h2^3/12
P2= (Fs*Ina1*4)/((h2/2)*12*La*3)
//RESULTS
printf ('P max in first case= %.2f lb',P1)
printf ('\n P max in second case= %.2f lb',P2)
```

Scilab code Exa 12.2 chapter 12 example 2

```
clc
//initialisation of variables
b= 0.5 //in
h= 1/32 //in
d= 4 //ft
E= 30*10^6
//CALCULATIONS
stress= E*(h/2)/((d/2)*12)
Ina= b*h^3/12
M= stress*Ina/(h/2)
//RESULTS
printf ('maximum stress= %.2f psi',stress)
printf ('\n internal moment= %.2f lb in',M)
```

Scilab code Exa 12.3 chapter 12 example 3

```
clc
//initialisation of variables
W= 1000 //lb/ft
L= 10 //in
b1= 4 //in
h1= 1 //in
b2= 1 //in
h2= 6 //in
//CALCULATIONS
Mmax= 12500 //lb ft
y= ((b1*h1*h1/2)+(b2*h2*((h2/2)+h1)))/(b1*h1+b2*h2)
Ina= (b1*h1^3/12)+b1*h1*(y-h1/2)^2+(b2*h2^3/12)+b2*
   h2*(h1+h2-y-(h2/2))^2
sigmat= Mmax*12*y/Ina
sigmac= Mmax*12*(h1+h2-y)/Ina
//RESULTS
printf ('maximum tensile stress= %.2f psi',sigmat)
```

```
17 printf ('\n maximum compressive bending stress= %.2f
       psi',sigmac)
```

Scilab code Exa 12.4 chapter 12 example 4

```
1  clc
2  //initialisation of variables
3  st= 1200 //psi
4  sc= 100 //psi
5  h= 12 //in
6  b= 4 //in
7  //CALCULATIONS
8  I= b*h^3/12
9  P1= st*I/(b*12*(h/2))
10 P2= 2*sc*b*12/3
11 if (P1<P2)
12     printf ('Safe value of p= %.f lB',P1)
13 else
14         printf ('Safe value of p= %.f lB',P2)
15
16 end
```

Scilab code Exa 12.5 chapter 12 example 5

```
1  clc
2  //initialisation of variables
3  W= 600 //lb/ft
4  L1= 8 //in
5  L2= 4 //in
6  b= 6 //in
7  h= 8 //in
8  t= 1 //in
9  //CALCULATIONS
```

```
10 R1= W*(L1+L2)*((L1+L2)/2)/L1
11 R2= W*(L1+L2)*(L1-(L1+L2)/2)/L1
12 Vmax= 3000 //lb
13 I= (b*h^3/12)-(L2*b^3/12)
14 Ay= b*L2*(L2/2)-L2*b/2*b/4
15 b= t+t
16 Tmax= Vmax*Ay/(I*b)
17 //RESULTS
18 printf ('maximum shear stress= %.2f psi',Tmax)
```

Scilab code Exa 12.6 chapter 12 example 6

```
1 clc
2 //initialisation of variables
3 w= 4000 //lb/ft
4 l= 20 //ft
5 y= 0.96
6 A= 4.18 //in^2
7 Icq= 5.6 //in^4
8 d= 28 //in
9 b= 0.5 //in
10 T= 8000 //psi
11 d1= 0.75 //in
12 //CALCULATIONS
13 V= w*l/2
14 Ay= 2*A*((d/2)-y)
15 I= b*d^3/12+4*(Icq+A*((d/2)-y)^2)
16 p= (2*T*(%pi/4)*d1^2*I)/(V*Ay)
17 //RESULTS
18 printf ('Rivet spacing= %.2f in',p)
```

Scilab code Exa 12.7 chapter 12 example 7

```
clc
//initialisation of variables
Es= 30*10^6
Ew= 1.5*10^6
w= 500 //lb per ft
span= 12 //ft
t= 0.25 //in
h= 12 //in
n= 3
b= 5 //in
//CALCULATIONS
bw= Es*t/Ew
Ina= n*b*h^3/12
M= (w*span*(h/2)*12)/4
S= M*(h/2)/I
Ss= Es*S/Ew
bs= Ew*bw/Es
Ina1= n*t*h^3/12
Ss1= M*(h/2)/Ina1
Sw= Ew*Ss1/Es
//RESULTS
printf ('Maximum bending stress in steel= %.3f psi',
   Ss1)
printf (' \n Maximum bending stress in wood= %.2f
   psi',Sw)
```

Scilab code Exa 12.8 chapter 12 example 8

```
clc
//initialisation of variables
Ss= 15000 //psi
Sa= 6000 //psi
Es= 30*10^6
Ea= 10*10^6
Sl= 16 //ft
```

```
ba= 3 //in
ha= 8 //in
hs= 1 //in
b= 1 //in
//CALCULATIONS
bs= (Ea/Es)*ba
Y= ((ba-b)*b*(hs/2)+(ha+b)*b*((ha/2)+(hs/2)))/(ba*b+
   ha*b)
I= (ba*hs^3/12)+ba*hs*(Y-(hs/2))^2+((b*ha^3/12)+b*ha
   *(ha-Y-(ha/2))^2)
w1= Ss*I/(Y*(1/2)*ha*(ha)*12)
Ss= Es*Sa/Ea
w2= Ss*I/((ha-Y)*(1/2)*ha*(ha)*12)
if (w1<w2)
    printf ('Greatest uniformly distributed load= %
       .2f lb per ft',w1)
else
    printf ('Greatest uniformly distributed load= %
       .2f lb per ft',w2)

end
```

Scilab code Exa 12.9 chapter 12 example 9

```
clc
//initialisation of variables
M= 500000 //lb in
r= 15
n=3
b= 20 //in
l= 12 //in
As= 1 //in^2
//CALCULATIONS
At= r*As*n
x= (-2*At+sqrt((2*At)^2+8*At*b*l))/(2*l)
```

```
12 Ina= ((l*x^3)/3)+At*(b-x)^2
13 Scmax= M*x/Ina
14 Ssmax= r*M*(b-x)/Ina
15 //RESULTS
16 printf ('Maximum bending stress in concrete= %.3f
      psi',Scmax)
17 printf (' \n Maximum bending stress in steel= %.2f
      psi',Ssmax)
```

Scilab code Exa 12.10 chapter 12 example 10

```
1 clc
2 //initialisation of variables
3 Sc= 800 //psi
4 Ss= 18000 //psi
5 ratio= 15
6 d= 5/8 //in
7 l= 20 //in
8 b= 10 //in
9 //CALCULATIONS
10 x= Sc*ratio*l/(Ss+Sc*ratio)
11 As= b*x*(x/2)/((l-x)*ratio)
12 Ina= (b*x^3/3)+ratio*As*(l-x)^2
13 M= Sc*I/x
14 N= As/(%pi*(d/2)^2)
15 //RESULTS
16 printf ('Number of steel bars required= %.2f',N)
17 disp("it rounds to 6 bars")
```

Chapter 13

Deflection in Beams

Scilab code Exa 13.1 chapter 13 example 1

```
clc
//initialisation of variables
E= 1.5*10^6
F1= -100 //lb
F2= -100 //lb
x1= 6 //in
x2= 6 //in
Ina= 64 //in^4
h1= -600 //lb ft
h2= -1200 //lb ft
xa1= 10 // in
xa2= 8 //in
//CALCULATIONS
deltamax= ((1/2)*x1*xa1*h1+(1/2)*(x1+x2)*h2*xa2)
   *(1728)/(E*Ina)
//RESULTS
printf ('maximum deflection= %.2f in',deltamax)
```

Scilab code Exa 13.2 chapter 13 example 2

```
clc
//initialisation of variables
E= 1.5*10^6
I= 50 //in^4
delta= -1 //in
l= 8 //ft
//CALCULATIONS
w= -delta*8*E*I/(l^4*1728)
//RESULTS
printf ('distributed weight= %.1f lb per ft',w)
```

Scilab code Exa 13.3 chapter 13 example 3

```
clc
//initialisation of variables
W= 50 //lb/ft
x= 5 //ft
x1= 2 //ft
//CALCULATIONS
V= W*x
M= W*((x/2)+x1)*x
M1= W*x*(x+x1)
M2= -M
M3= -W*x*x/2
EIdeltamax= ((1/2)*(x+x1)*M1*((x+x1)/3))+(x+x1)*M2
   *((x+x1)/2)+(1/3)*x*M3*(x/4)
//RESULTS
printf ('maximum value of EIdeltax= %.1f lb ft^3',
   EIdeltamax)
```

Scilab code Exa 13.5 chapter 13 example 5

```
clc
```

```
2 //initialisation of variables
3 w= 180 //lb/ft
4 l= 8 //ft
5 P= 1200 //lb
6 b= 6 //ft
7 E= 3*10^6
8 I= 64 //in^4
9 //CALCULATIONS
10 delta= ((w*l^4)/(8))+((P*b^2)*(3*l-b)/(6))
11 //RESULTS
12 printf ('deflection of the free end= %.1fbyEI ft',
   delta)
```

Scilab code Exa 13.6 chapter 13 example 6

```
1 clc
2 //initialisation of variables
3 P= 6 //kips
4 w= 3 //kips/ft
5 L1= 8 //ft
6 L2= 8 //ft
7 //CALCULATIONS
8 delta= (P*(L1+L2)^3/192)+(w*(L1+L2)^4/768)
9 //RESULTS
10 printf ('midspan value of deflection= %.1f kip ft^3'
   ,delta)
```

Scilab code Exa 13.7 chapter 13 example 7

```
1 clc
2 //initialisation of variables
3 x1= 3 //ft
4 x2= 3 //ft
```

```
x3= 3 //ft
x4= 3 //ft
W1= 4 //kips
W2= 8 //kips
l= x1+x2+x3+x4
//CALCULATIONS
b= x2+x3+x4
b1= x4
a= x1
x= l/2
P= (((W1*b*(l/b*(x-a)^3+(l^2-b^2)*x-x^3))/(6*l))+((
   W2*b1*x*(l^2-x^2-b1^2))/(6*l)))*(48/l^3)
R1= 3+2-(P/2)
R2= P
R3= 1+6-(P/2)
//RESULTS
printf ('R1= %.3f kips',R1)
printf (' \n R2=%.2f kips',R2)
printf (' \n R3=%.3f kips',R3)
```

Scilab code Exa 13.8 chapter 13 example 8

```
clc
//initialisation of variables
P= 680 //lb
K= 1000 //lb/in
L= 6 //ft
E= 30*10^6
Ina= 1.728 //in^4
//CALCULATIONS
A= [((L*12)^3/(3*E*Ina)),-(1/K);1,1]
b= [0;P]
c= A\b
Pb= c(1,1)
Ps= c(2,1)
```

```
14 //RESULTS
15 printf ('Force in the spring= %.2f psi',Ps)
```

Scilab code Exa 13.9 chapter 13 example 9

```
1 clc
2 //initialisation of variables
3 I= 1.5 //in^4
4 Da= 0.5 //in
5 E= 30*10^6
6 l= 60 //in
7 //CALCULATIONS
8 F= 6*Da*E*I/(l^3)
9 //RESULTS
10 printf ('F= %.2f lb',F)
```

Chapter 14

Combined Loading

Scilab code Exa 14.1 chapter 14 example 1

```
1  clc
2  //initialisation of variables
3  h= 6 //in
4  x1= 7 //in
5  x2= 1 //in
6  x3= 2 //in
7  P= 600 //lb
8  //CALCULATIONS
9  By= P*(x1+x2+x3)/(x1+x2)
10 Bx= By*(x1+x2)/h
11 Fx= Bx
12 V= By-P
13 M= -P*(x2+x3)+By*x2
14 S1= -Fx/(x3*h)
15 I= x3*h^3/12
16 S2= -M*12*(h/2)/I
17 Scmax= S1-S2
18 Stmax= S1+S2
19 //RESULTS
20 printf ('Maximum tensile stress at = %.1f psi',Scmax
   )
```

```
21 printf (' \n Maximum compressive stress at = %.1f
      psi',Stmax)
```

Scilab code Exa 14.2 chapter 14 example 2

```
1  clc
2  //initialisation of variables
3  P= 10000 //lb
4  A= 11.77 //in^2
5  Z= 51.9 //in^3
6  x= 5 //ft
7  y= 12 //ft
8  //CALCULATIONS
9  S1= -P/A
10 S2= P*x*y/Z
11 Sc= S1-S2
12 St= S1+S2
13 //RESULTS
14 printf ('Axial stress at c= %.1f psi',Sc)
15 printf (' \n Axial stress at t= %.1f psi',St)
```

Scilab code Exa 14.3 chapter 14 example 3

```
1  clc
2  //initialisation of variables
3  b= 6 //in
4  h= 12 //in
5  l= 20 //ft
6  P= 100000 //lb
7  //CALCULATIONS
8  S= -P/(b*h)
9  S1= l^2*6*12/(8*b*h^2)
10 w= -S/S1
```

```
11 //RESULTS
12 printf ('Safe distributed load= %.1f lb per ft',w)
```

Scilab code Exa 14.4 chapter 14 example 4

```
1 clc
2 //initialisation of variables
3 b= 4 //in
4 h= 9 //in
5 l= 6 //in
6 Mx= 600 //lb
7 My= 100 //lb
8 //CALCULATIONS
9 Zx= b*h^3/(12*h/2)
10 Zy= b^3*h/(12*b/2)
11 S1= Mx*l*12/Zx
12 S2= My*b*12/Zy
13 Sb= S1+S2
14 Sd= -S1-S2
15 //RESULTS
16 printf ('Maximum stress= %.1f psi (tension)',Sb)
17 printf (' \n Maximum stress=%.1f psi (compression)',
   Sd)
```

Scilab code Exa 14.5 chapter 14 example 5

```
1 clc
2 //initialisation of variables
3 d= 2 //in
4 Px= -600 //lb
5 Py= 1200 //lb
6 x1= 2 //in
7 x2= 2 //in
```

```
x3= 2 //in
Ray= -400 //lb
Rax= 400 //lb
Rbx= 200 //lb
Rby= -800 //lb
//CALCULATIONS
Mb= sqrt((Rax*x1)^2+(Ray*x1)^2)
Mc=sqrt((Rbx*x3)^2+(Rby*x3)^2)
if (Mb<Mc)
    M=Mc
else
    M= Mb
end
Smax= M*12*64*(d/2)/(%pi*d^4)
//RESULTS
printf ('Maximum normal stress= %.1f psi',Smax)
```

Scilab code Exa 14.6 chapter 14 example 6

```
clc
//initialisation of variables
P= 100 //kips
M= 400 //kip in
A= 14.7 //in^2
Z= 80.7 //in^3
//CALCULATIONS
Smax= -(P*10^3)/A-(M*10^3)/Z
Smin= -(P*10^3)/A+(M*10^3)/Z
//RESULTS
printf ('Maximum stress= %.1f psi',Smax)
printf (' \n Minimum stress=%.1f psi',Smin)
```

Scilab code Exa 14.7 chapter 14 example 7

```
clc
//initialisation of variables
As= 1 //in^2
Zs= 0.167 //in^3
Ah= 1 //in^2
Zh= 0.984 //in^3
es= 0.5 //in
eh= 0.5 //in
//CALCULATIONS
phbyps= (1/As+es/Zs)/(1/Ah+eh/Zh)
//RESULTS
printf ('ratio= %.1f',phbyps)
```

Scilab code Exa 14.8 chapter 14 example 8

```
clc
//initialisation of variables
Sx= 1800 //psi
Sy= 1000 //psi
angle= 30 //degrees
t= 0.25 //in
t1= 3 //in
t2= 5 //in
//CALCULATIONS
Sx1= Sx/(t1*t)
Sy1= Sy/(t2*t)
S= ((Sx+Sy)/2+((Sx-Sy)/2)*cosd(2*angle))+(Sx-Sy)*
   cosd(2*angle)
T= (Sx-Sy)*sind(2*angle)
//RESULTS
printf ('S= %.1f psi',S)
printf (' \n T=%.1f psi',T)
```

Scilab code Exa 14.9 chapter 14 example 9

```
clc
//initialisation of variables
Sx= 1800 //lb
Sy= 1000 //lb
angle= 30 //degrees
//CALCULATIONS
Sa=-((Sx+Sy)/2+((Sx-Sy)/2)*cosd(2*angle))*cosd(2*
   angle)-(Sx-Sy)
Ta= -((Sx+Sy)/2+((Sx-Sy)/2)*cosd(2*angle))*sind(2*
   angle)
Sb=((Sx+Sy)/2+((Sx-Sy)/2)*cosd(2*angle))*cosd(2*
   angle)-(Sx-Sy)
Tb= ((Sx+Sy)/2+((Sx-Sy)/2)*cosd(2*angle))*sind(2*
   angle)
//RESULTS
printf ('Sa= %.1f psi',Sa)
printf ('\n Sb=%.1f psi',Sb)
printf ('\n Ta=%.1f psi',Ta)
printf ('\n Tb=%.1f psi',Tb)
```

Scilab code Exa 14.10 chapter 14 example 10

```
clc
//initialisation of variables
angle= 15 //degrees
Tyx= -1000 //psi
Txy= 1000 //psi
//CALCULATIONS
Sx= Txy*sind(2*angle)
Tx= Txy*cosd(2*angle)
Sy= Tyx*sind(2*angle)
Ty= Tyx*cosd(2*angle)
Sx1= Txy
```

```
Sy1= Tyx
Txy= 0
//RESULTS
printf ('Sx= %.1f psi',Sx)
printf (' \n Tx=%.1f psi',Tx)
printf (' \n Sy=%.1f psi',Sy)
printf (' \n Ty=%.1f psi',Ty)
printf (' \n Sx1=%.1f psi',Sx1)
printf (' \n Sy1=%.1f psi',Sy1)
printf (' \n Txy=%.1f psi',Txy)
```

Scilab code Exa 14.11 chapter 14 example 11

```
clc
//initialisation of variables
d= 4 //in
n= 315 //rpm
Ss= 8000 //psi
Ns= 12000 //psi
//CALCULATIONS
T= Ss*%pi*d^4/(32*(d/2))
hp= T*n/63000
//RESULTS
printf ('T= %.1f lb in',T)
printf (' \n horsepower rating=%.1f hp',hp)
```

Scilab code Exa 14.12 chapter 14 example 12

```
clc
//initialisation of variables
Sx= 9 //ksi
Sy= -5 //ksi
Txy= 4 //ksi
```

```
6  //CALCULATIONS
7  R= sqrt(((Sx-Sy)/2)^2+Txy^2)
8  Smax= ((Sx+Sy)/2)+R
9  Smin= ((Sx+Sy)/2)-R
10 ap1= (1/2)*atand(2*Txy/(Sx-Sy))
11 ap2= 90+ap1
12 Sc= (Sx+Sy)/2
13 Tc= R
14 Sd= (Sx+Sy)/2
15 Td= -R
16 a1= (90-2*ap1)/2
17 a2= 90+a1
18 //RESULTS
19 printf ('Smax= %.1f ksi',Smax)
20 printf (' \n Smin=%.1f ksi',Smin)
21 printf (' \n R=%.1f psi',R)
22 printf (' \n palne1=%.1f degrees',ap1)
23 printf (' \n plane 2=%.1f degrees',ap2)
24 printf (' \n Sc=%.1f ksi',Sc)
25 printf (' \n Sd=%.1f ksi',Sd)
26 printf (' \n Tc=%.1f ksi',Tc)
27 printf (' \n Td=%.1f ksi',Td)
28 printf (' \n palne1=%.1f degrees',a1)
29 printf (' \n plane 2=%.1f degrees',a2)
```

Scilab code Exa 14.13 chapter 14 example 13

```
1  clc
2  //initialisation of variables
3  d= 4 //in
4  T= 40000 //lb in
5  Th= 20000 //lb in
6  //CALCULATIONS
7  t= T*(d/2)*32/(%pi*d^4)
8  S= Th/(%pi*(d/2)^2)
```

```
Smax= -(S/2)-sqrt(t^2+(S/2)^2)
Tmax= sqrt(t^2+(S/2)^2)
//RESULTS
printf ('Maximum normal stress= %.1f psi',Smax)
printf (' \n Maximum shearing stress=%.1f psi',Tmax)
```

Chapter 15

Welded Bolted and Riveted Connection

Scilab code Exa 15.1 chapter 15 example 1

```
clc
//initialisation of variables
sigma= 20000 //psi
b= 6 //in
h= 0.5 //in
p1= 3750
//CALCULATIONS
P= sigma*b*h
L= (P-p1*b)/(2*p1)
//RESULTS
printf ('L= %.2f in',L)
```

Scilab code Exa 15.2 chapter 15 example 2

```
clc
//initialisation of variables
```

```
P= 5000 //lb per in
Tl= 75 //kips
y1= 2.63 //in
y2= 1.37 //in
//CALCULATIONS
A= [P P ; y1*P -y2*P]
b= [Tl*10^3 ; 0]
c= A\b
L1= c(1,1)
L2= c(2,1)
//RESULTS
printf ('L1= %.2f in',L1)
printf ('\n L2= %.2f in',L2)
```

Scilab code Exa 15.3 chapter 15 example 3

```
clc
//initialisation of variables
d= 3/8 //in
d1= 1/8 //in
y= 1 //in
T= 15000 //psi
sigmab= 32000 //psi
sigmat= 18000 //psi
//CALCULATIONS
Ps= %pi*T*(d/2)^2
Pt= sigmat*d1*(y-d)
Pb= sigmab*d1*d
Pmin=Ps
sigma=T
if(Pt<Pmin)
    Pmin=Pt
    sigma=sigmat
else
    Pmin=Pb
```

```
20      sigma=sigmab
21  end
22  e= Pmin*100/(sigma*d1*y)
23  //RESULTS
24  printf ('e= %.2f per cent',e)
```

Scilab code Exa 15.4 chapter 15 example 4

```
1   clc
2   //initialisation of variables
3   d= 7/8 //in
4   Ss= 15000 //psi
5   Sb= 32000 //psi
6   St= 20000 //psi
7   n=8
8   t= 3/8 //in
9   l= 10 //in
10  //CALCULATIONS
11  Ps= Ss*%pi*n*(d/2)^2
12  Pb= Sb*%pi*n*d*t
13  Pt1= St*(l-d*2)*t
14  Pt2= 4*St*(l-d*4)*t/3
15  Pt3= 4*St*(l-d*2)*t
16  Pmin= Ps
17  sigma= Ss
18  if (Pb<Pmin)
19      Pmin=Pb
20      sigma=Sb
21  elseif (Pt1<Pmin)
22      Pmin=Pt1
23      sigma=St
24  elseif (Pt2<Pmin)
25      Pmin=Pt2
26      sigma=St
27  else (Pt3<Pmin)
```

```
28      Pmin=Pt3
29      sigma=St
30  end
31  e= Pmin*100/(sigma*t*l)
32  //RESULTS
33  printf ('e= %.1f per cent',e)
```

Scilab code Exa 15.5 chapter 15 example 5

```
1  clc
2  //initialisation of variables
3  n= 8
4  shear= 15 //ksi
5  Dr= 7/8 //in
6  Ss= 32 //ksi
7  Ds= 40 //si
8  D= 3/8 //in
9  x= 0.504 //in
10 //CALCULATIONS
11 Ps= shear*n*(Dr/2)^2
12 Pb= Ds*(n/2)*x*Dr
13 Pb1= Ss*n*D*Dr
14 pmin= Ps
15 if (Pb<Pmin)
16     Pmin= Pb
17 else
18     Pmin= Pb1
19     end
20 //RESULTS
21 printf ('load capacity of connection= %.2f kips',Pb)
```

Scilab code Exa 15.6 chapter 15 example 6

```
clc
//initialisation of variables
T= 15000 //psi
x1= 3 //in
x2= 3 //in
y1= 3 //in
y2= 3 //in
d= 0.5 //in
n= 4
//CALCULATIONS
P= T*(%pi/4)*d^2/(sqrt((1/n)^2+(1/((sqrt(y1^2+y2^2)/
   y1)*n))^2+(2*(1/n)*(1/(n*(sqrt(y1^2+y2^2))/y1))*
   cosd(45))))
P1= T*(%pi/4)*d^2/((1/n)+(y1/(n*y1)))
if (P>P1)
    printf ('Stornger P= %.2f lb',P)
else
    printf ('Stornger  P= %.2f lb',P1)
end
```

Scilab code Exa 15.7 chapter 15 example 7

```
clc
//initialisation of variables
P= 5 //kips
xab= 3 //in
xbc= 6 //in
xbp= 1 //in
y= 6 //in
n= 3
//CALCULATIONS
Dl= P/3
Pct= (6*P)/(((xab+xbp)*(xab+xbp)/(xbc-xbp))+(xbp/(
   xbc-xbp))+(xbc-xbp))
R= sqrt(Pct^2+Dl^2)
```

```
13 //RESULTS
14 printf ('Greatest Load= %.2f kips',R)
```

Chapter 16

Columns

Scilab code Exa 16.1 chapter 16 example 1

```
clc
//initialisation of variables
E= 10*10^6 //psi
ys= 6000 //psi
//CALCULATIONS
lbyr= sqrt(%pi^2*E/ys)
//RESULTS
printf ('Slenderness Ratio= %.f ',lbyr)
```

Scilab code Exa 16.2 chapter 16 example 2

```
clc
//initialisation of variables
fs= 3
W= 50 //kips
l= 20 //ft
E= 30*10^6 //psi
//CALCULATIONS
```

```
Pcr= fs*W
I= Pcr*10^3*(l*12)^2/(%pi^2*E)
r= 2.01
lbyr= l/r
//RESULTS
printf ('Required I = %.2f in^4',I)
printf (' \n slenderness ratio=%.2f ',lbyr)
```

Scilab code Exa 16.3 chapter 16 example 3

```
clc
//initialisation of variables
L1= 18 //ft
L2= 9 //ft
I1= 12.1 //in^4
I2= 1.2 //in^4
E= 30*10^6 //psi
//CALCULATIONS
r1= 2.05
lbyr= L1*12/r1
r2= 0.65
lbyr2= L2*12/r2
Pcr1= %pi^2*E*I1/(L1*12)^2
Pcr2= %pi^2*E*I2/(L2*12)^2
P= Pcr1/2.5
P2= Pcr2/2.5
//RESULTS
printf ('Design load of 1= %.2f lb',P)
printf (' \n Design load of 2=%.2f lb',P2)
```

Scilab code Exa 16.4 chapter 16 example 4

```
clc
```

```
2 //initialisation of variables
3 E= 30*10^6
4 syp= 30000 //psi
5 I= 143.5 //in^4
6 A= 7.32 //in
7 //CALCULATIONS
8 I1= 2*I
9 A1= 2*A
10 L= sqrt(2*%pi^2*E*I1/(syp*A1))
11 //RESULTS
12 printf ('Critical length of the column= %.2f in',L)
```

Scilab code Exa 16.5 chapter 16 example 5

```
1 clc
2 //initialisation of variables
3 x= 30 //in
4 x1= 10 //in
5 E= 30*10^6
6 d= 0.5 //in
7 syp= 60000 //psi
8 y1= 8 //in
9 y2= 2 //in
10 //CALCULATIONS
11 ratio= 0.8
12 l= x+x1
13 lr= ratio*l
14 I= (%pi*(d)^4)/64
15 Pcr= %pi^2*E*I/lr^2
16 scr= Pcr/(%pi*(d/2)^2)
17 F= Pcr*y2/(y1+y2)
18 //RESULTS
19 printf ('Stress in the critical load= %.2f psi',scr)
20 printf (' \n Critical force F=%.2f lb',F)
```

Scilab code Exa 16.6 chapter 16 example 6

```
clc
//initialisation of variables
l= 10 //ft
Ys= 33000 //psi
E= 30*10^6
A= 13.24 //in^4
//CALCULATIONS
r= 2
lbyr= l*12/r
Cc= sqrt(2*%pi^2*E/Ys)
fs= 5/3+3*(lbyr)/(8*Cc)+(lbyr)^3/(5*Cc^3)
Sa=((1-((lbyr)^2/(2*Cc^2)))*(Ys))/fs
Pa= Sa*A
//RESULTS
printf ('Premissible load= %.2e kips',Pa)
```

Scilab code Exa 16.7 chapter 16 example 7

```
clc
//initialisation of variables
L= 12 //ft
Po= 100 //kips
e= 2 //ft
ys= 42000 //psi
A= 11.77 //in^2
rmin= 195 //in
Zmin= 11.0 //in^3
lbyr= 74.2
stress= 18 //ksi
//CALCULATIONS
```

```
13 P= (stress-(Po/A)/((1/A)+((e*12)/Zmin)))
14 //RESULTS
15 printf ('Additional Load= %.2f kips ',P)
```

Scilab code Exa 16.8 chapter 16 example 8

```
1  clc
2  //initialisation of variables
3  l= 15 //ft
4  Al= 80 //kips
5  El= 60 //kips
6  Ys= 33 //ksi
7  e= 4 //in
8  //CALCULATIONS
9  A= 14.4
10 rmin= 2.54
11 Zxx= 54.6
12 lbyr= l*12/rmin
13 Smax= ((Al+El)/A)+El*e/Zxx
14 //RESULTS
15 printf ('Maximum stress %.2f ksi',Smax)
16 disp("10 WF 49 is the suitable one")
```