

Scilab Textbook Companion for  
Aircraft Structures For Engineering Students  
by T. H. G. Megson<sup>1</sup>

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# Book Description

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

**Exa** Example (Solved example)

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

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

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

# Contents

List of Scilab Codes	4
1 Basic Elasticity	6
3 Torsion of Solid Section	14
4 Virtual work and Energy methods	21
5 Energy Methods	27
6 Matrix Methods	35
7 Bending of Thin plates	41
8 Columns	47
9 Thin plates	52
10 Oscillation of mass spring systems	54
12 Structural components of aircraft	59
14 Airframe Loads	61
15 Fatigue	64
16 Bending of open and closed thin walled beams	65
17 Shear of beams	90

18 Torsion of beams	94
19 Combined open and closed section beams	100
20 Structural idealization	104
21 Wing spars and box beams	108
22 Fuselages	113
23 Wings	116
24 Fuselage frames and wing ribs	123
25 Laminated composites	127
26 closed section beams	137
27 Open section beams	143

# List of Scilab Codes

Exa 1.1	Example 1	6
Exa 1.2	Example 2	7
Exa 1.3	Example 3	8
Exa 1.4	Example 4	10
Exa 1.5	Example 5	10
Exa 1.7	Example 7	11
Exa 3.1	Example 1	14
Exa 3.2	Example 2	15
Exa 4.1	Example 1	21
Exa 4.2	Example 2	22
Exa 4.3	Example 3	23
Exa 4.4	Example 4	23
Exa 4.5	Example 5	25
Exa 4.6	Example 6	25
Exa 5.1	Example 1	27
Exa 5.2	Example 2	28
Exa 5.3	Example 3	29
Exa 5.4	Example 4	29
Exa 5.5	Example 5	30
Exa 5.6	Example 6	31
Exa 5.7	Example 7	31
Exa 5.8	Example 8	32
Exa 5.9	Example 9	32
Exa 5.10	Example 10	33
Exa 5.11	Example 11	34
Exa 5.12	Example 12	34
Exa 6.1	Example 1	35
Exa 6.2	Example 2	39

Exa 6.4	Example 4	39
Exa 7.1	Example 1	41
Exa 7.3	Example 3	43
Exa 7.4	Example 4	45
Exa 8.2	Example 2	47
Exa 8.3	Example 3	49
Exa 8.4	Example 4	50
Exa 9.1	Example 1	52
Exa 10.1	Example 1	54
Exa 10.2	Example 2	55
Exa 10.4	Example 4	55
Exa 10.5	Example 5	56
Exa 10.6	Example 6	58
Exa 12.1	Example 1	59
Exa 12.2	Example 2	59
Exa 14.1	Example 1	61
Exa 14.2	Example 2	62
Exa 14.3	Example 3	62
Exa 15.1	Example 1	64
Exa 16.1	Example 1	65
Exa 16.2	Example 2	67
Exa 16.3	Example 3	68
Exa 16.4	Example 4	70
Exa 16.5	Example 5	71
Exa 16.6	Example 6	73
Exa 16.7	Example 7	75
Exa 16.8	Example 8	76
Exa 16.9	Example 9	77
Exa 16.10	Example 10	79
Exa 16.11	Example 11	83
Exa 16.12	Example 12	83
Exa 16.13	Example 13	85
Exa 16.14	Example 14	87
Exa 16.15	Example 15	88
Exa 16.16	Example 16	88
Exa 17.1	Example 1	90
Exa 17.2	Example 2	92
Exa 17.3	Example 3	93

Exa 18.1	Example 1	94
Exa 18.2	Example 2	95
Exa 18.3	Example 3	98
Exa 19.1	Example 1	100
Exa 19.2	Example 2	102
Exa 20.1	Example 1	104
Exa 20.2	Example 2	105
Exa 20.3	Example 3	105
Exa 20.4	Example 4	106
Exa 21.1	Example 1	108
Exa 21.2	Example 2	110
Exa 21.3	Example 3	111
Exa 22.1	Example 1	113
Exa 22.2	Example 2	114
Exa 23.1	Example 1	116
Exa 23.2	Example 2	117
Exa 23.3	Example 3	117
Exa 23.4	Example 4	119
Exa 23.6	Example 6	120
Exa 24.1	Example 1	123
Exa 24.2	Example 2	125
Exa 25.1	Example 1	127
Exa 25.2	Example 2	128
Exa 25.3	Example 3	128
Exa 25.4	Example 4	129
Exa 25.5	Example 5	130
Exa 25.6	Example 6	130
Exa 25.7	Example 7	133
Exa 25.8	Example 8	134
Exa 26.1	Example 1	137
Exa 26.2	Example 2	139
Exa 26.3	Example 3	139
Exa 26.4	Example 4	140
Exa 27.2	Example 2	143
AP 1	Example 27.2 data	146
AP 2	Example 26.4 data	146
AP 3	Example 26.3 data	146
AP 4	Example 26.2 data	147



AP 5	Example 26.1 data . . . . .	147
AP 6	Example 25.8 data . . . . .	147
AP 7	Example 25.7 data . . . . .	147
AP 8	Example 25.6 data . . . . .	148
AP 9	Example 25.5 data . . . . .	148
AP 10	Example 25.4 data . . . . .	148
AP 11	Example 25.3 data . . . . .	149
AP 12	Example 25.2 data . . . . .	149
AP 13	Example 25.1 data . . . . .	149
AP 14	Example 24.2 data . . . . .	150
AP 15	Example 24.1 data . . . . .	150
AP 16	Example 23.6 data . . . . .	150
AP 17	Example 23.4 data . . . . .	150
AP 18	Example 23.3 data . . . . .	151
AP 19	Example 23.2 data . . . . .	151
AP 20	Example 23.1 data . . . . .	152
AP 21	Example 22.2 data . . . . .	152
AP 22	Example 22.1 data . . . . .	152
AP 23	Example 21.3 data . . . . .	152
AP 24	Example 21.2 data . . . . .	153
AP 25	Example 21.1 data . . . . .	153
AP 26	Example 20.4 data . . . . .	153
AP 27	Example 20.3 data . . . . .	154
AP 28	Example 20.2 data . . . . .	154
AP 29	Example 20.1 . . . . .	154
AP 30	Example 19.2 data . . . . .	154
AP 31	Example 19.1 data . . . . .	155
AP 32	Example 18.3 data . . . . .	155
AP 33	Example 18.2 data . . . . .	155
AP 34	Example 18.1 data . . . . .	155
AP 35	Example 17.3 data . . . . .	156
AP 36	Example 17.2 data . . . . .	156
AP 37	Example 17.1 data . . . . .	156
AP 38	Example 16.9 data . . . . .	156
AP 39	Example 16.8 data . . . . .	156
AP 40	Example 16.7 data . . . . .	156
AP 41	Example 16.6 data . . . . .	157
AP 42	Example 16.5 data . . . . .	157

AP 43	Example 16.4 data . . . . .	157
AP 44	Example 16.3 data . . . . .	157
AP 45	Example 16.2 data . . . . .	157
AP 46	Example 16.16 data . . . . .	158
AP 47	Example 16.15 data . . . . .	158
AP 48	Example 16.14 data . . . . .	158
AP 49	Example 16.13 data . . . . .	158
AP 50	Example 16.12 data . . . . .	159
AP 51	Example 16.11 data . . . . .	159
AP 52	Example 16.10 data . . . . .	159
AP 53	Example 16.1 data . . . . .	159
AP 54	Example 15.1 data . . . . .	159
AP 55	Example 14.3 data . . . . .	160
AP 56	Example 14.2 data . . . . .	160
AP 57	Example 14.1 data . . . . .	160
AP 58	Example 12.2 data . . . . .	161
AP 59	Example 12.1 data . . . . .	161
AP 60	Example 10.6 data . . . . .	161
AP 61	Example 10.5 data . . . . .	161
AP 62	Example 10.4 data . . . . .	161
AP 63	Example 10.2 data . . . . .	162
AP 64	Example 10.1 data . . . . .	162
AP 65	Example 9.1 data . . . . .	162
AP 66	Example 8.4 data . . . . .	162
AP 67	Example 8.3 data . . . . .	163
AP 68	Example 8.2 data . . . . .	163
AP 69	Example 7.4 data . . . . .	163
AP 70	Example 7.3 data . . . . .	163
AP 71	Example 7.1 data . . . . .	164
AP 72	Example 6.4 data . . . . .	164
AP 73	Example 6.2 data . . . . .	164
AP 74	Example 6.1 data . . . . .	164
AP 75	Example 5.9 data . . . . .	165
AP 76	Example 5.8 data . . . . .	165
AP 77	Example 5.7 data . . . . .	165
AP 78	Example 5.6 data . . . . .	165
AP 79	Example 5.5 data . . . . .	165
AP 80	Example 5.4 data . . . . .	166

AP 81	Example 5.3 data	166
AP 82	Example 5.2 data	166
AP 83	Example 5.12 data	166
AP 84	Example 5.11 data	166
AP 85	Example 5.10 data	167
AP 86	Example 5.1 data	167
AP 87	Example 4.6 data	167
AP 88	Example 4.5 data	167
AP 89	Example 4.4 data	168
AP 90	Example 4.3 data	168
AP 91	Example 4.2 data	168
AP 92	Example 4.1 data	168
AP 93	Example 3.2 data	168
AP 94	Example 3.1 data	169
AP 95	Example 1.7 data	169
AP 96	Example 1.5 data	169
AP 97	Example 1.4 data	169
AP 98	Example 1.3 data	169
AP 99	Example 1.2 data	169
AP 100	Example 1.1 data	170

# List of Figures

1.1	Example 3	9
1.2	Example 5	12
3.1	Example 1	16
3.2	Example 1	17
3.3	Example 2	19
3.4	Example 2	20
4.1	Example 2	22
4.2	Example 4	24
6.1	Example 1	36
6.2	Example 2	38
7.1	Example 1	42
7.2	Example 3	44
7.3	Example 4	45
8.1	Example 2	48
10.1	Example 5	56
16.1	Example 1	66
16.2	Example 2	67
16.3	Example 3	69
16.4	Example 5	72
16.5	Example 6	74
16.6	Example 7	75
16.7	Example 8	76
16.8	Example 9	78

16.9 Example 10 . . . . .	80
16.10 Example 11 . . . . .	82
16.11 Example 12 . . . . .	84
16.12 Example 14 . . . . .	86
17.1 Example 1 . . . . .	91
18.1 Example 2 . . . . .	95
18.2 Example 3 . . . . .	97
19.1 Example 1 . . . . .	101
21.1 Example 1 . . . . .	109
23.1 Example 6 . . . . .	121
24.1 Example 1 . . . . .	124
25.1 Example 6 . . . . .	131
25.2 Example 7 . . . . .	133
25.3 Example 8 . . . . .	135
26.1 Example 2 . . . . .	138
26.2 Example 4 . . . . .	141
27.1 Example 2 . . . . .	144

# Chapter 1

## Basic Elasticity

check Appendix [AP 100](#) for dependency:

```
1_01data.sci
```

Scilab code Exa 1.1 Example 1

```
1 pathname=get_absolute_file_path('1_01.sce')
2 filename=pathname+filesep()+ '1_01data.sci'
3 exec(filename)
4 Sx1= p*d/(4*t);
5 Sy= p*d/(2*t); // y
6 printf("\nLongitudnal stress produced by internal
   pressure: %f N/mm^2",Sx1);
7 printf("\nCircumferential stress produced by
   internal pressure ( y ): %f N/mm^2",Sy);
8 Sx2= Load/(%pi*d*t);
9 printf("\ndirect stress due to the axial load: %f N/
   mm^2",Sx2);
10 Sx= Sx1+Sx2; // x
11 printf("\n x is: %f N/mm^2",Sx);
12 printf("\n y is: %f N/mm^2",Sy);
13 Sn=(Sx)*(cos(theta))^2 + Sy*(sin(theta))^2; // n
14 T= (Sx-Sy)*sin(2*(theta)) /2; //
```

```

15 printf("\n n is: %f N/mm^2",Sn);
16 printf("\n is: %f N/mm^2",T);
17 Tmax= (Sx-Sy)/2; // max
18 printf("\n max: %f N/mm^2",Tmax);

```

---

check Appendix [AP 99](#) for dependency:

1\_02data.sci

### Scilab code Exa 1.2 Example 2

```

1 pathname=get_absolute_file_path('1_02.sce')
2 filename=pathname+filesep()+ '1_02data.sci'
3 exec(filename)
4 printf("\nbending moment due to direct loading in a
    vertical plane: %f N/mm^2",Load*t);
5 Sx1= Load/(%pi*(d^2)/4); // x (axial load)
6 printf("\n x (axial load) is: %f N/mm^2",Sx1);
7 I= %pi*(d^4)/64; // moment of Inertia
8 Sx2= t*Load*(d/2)*(1/I); // x (bending moment)
9 printf("\n x (bending moment) is: %f N/mm^2",Sx2)
10 Sx=Sx1+Sx2; // x
11 J= %pi*(d^4)/32; //torsion constant
12 Txy=T*(d/2)*(1/J); // xy
13 printf("\nSince the element is positioned at the
    bottom of the beam\n xy:%fN/mm^2",-Txy);
14 printf("\n x: %f N/mm^2",-Sx);
15 Sn=(-Sx)*(cos(theta))^2 +(-Txy)*sin(2*theta); // n
16 T= (-Sx-0)*sin(2*theta)/2 -(-Txy)*cos(2*theta); //
17 printf("\n n : %f N/mm^2",Sn);
18 printf("\n : %f N/mm^2)",T);

```

---

check Appendix [AP 98](#) for dependency:

1\_03data.sci

### Scilab code Exa 1.3 Example 3

```
1 pathname=get_absolute_file_path('1_03.sce')
2 filename=pathname+filesep()+ '1_03data.sci'
3 exec(filename)
4 Txy=((1Load-Sx)*(1Load-Sy))^0.5;
5 printf("\n xy :%f N/mm^2",Txy);
6 printf(" ,%f N/mm^2" ,-Txy);
7 S=poly(0, 'S');
8 y=(S^2)-(S*(Sx+Sy))+(Sx*Sy)-(Txy^2);
9 m=roots(y);
10 printf("\n 1 : %f N/mm^2",m(2,:));
11 printf("\n 2 :%f N/mm^2",m(1,:));
12 Tmax=abs((m(2,:)-m(1,:))/2);
13 printf("\n max : %f N/mm^2",Tmax);
14 //plotting mohr circle
15 x=abs((m(2,:)+m(1,:))/2); //Centre of circle
16 plot2d(0,0,-1,"031", " ", [x-Tmax-50,-Tmax-50,x+Tmax
    +100,Tmax+50]);
17 xgrid(3);
18 xarc(x-Tmax,Tmax,2*Tmax,2*Tmax,0,360*64);
19 x1=[m(1,:),m(2,)],y1=[0,0];
20 x2=[Sx,Sy],y2=[Txy,-Txy];
21 x3=[Sx,Sx],y3=[Txy,0];
22 x4=[Sy,Sy],y4=[-Txy,0];
23 x5=[x,x],y5=[Tmax,-Tmax];
24 plot(x1,y1,x2,y2,'—',x3,y3,'—',x4,y4,'—',x5,y5,'
    —');
25 datatipToggle();
26 printf("\n\nclick on the point to view its
    coordinate on the plot");
27 xtitle(' Mohr s circle of stress ', ' (N/mm^2)',
    ' (N/mm^2)', boxed = 1 );
```

---

check Appendix [AP 97](#) for dependency:

1\_04data.sci



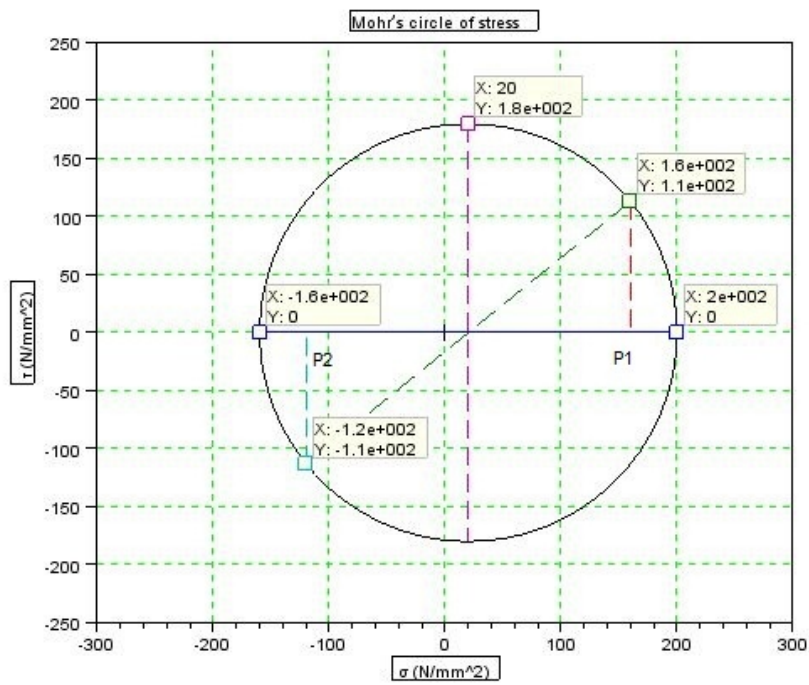


Figure 1.1: Example 3

#### Scilab code Exa 1.4 Example 4

```
1 pathname=get_absolute_file_path('1_04.sce')
2 filename=pathname+filesep()+ '1_04data.sci'
3 exec(filename)
4 Ex= (1/E)*(Sx-v*Sy); // x
5 Ey= (1/E)*(Sy-v*Sx); // y
6 Ez= (1/E)*(0-v*(Sx+Sy)); // z
7 printf("\n x : %f",Ex);
8 printf("\n y : %f",Ey);
9 printf("\n z : %f",Ez);
10 Tmax=(Sx-Sy)/2; // max
11 Gmax=2*(1+v)*Tmax/E; // max
12 printf("\n max : %f",Gmax);
13 printf("\n max : %f N/mm^2",Tmax);
```

---

check Appendix [AP 96](#) for dependency:

1\_05data.sci

#### Scilab code Exa 1.5 Example 5

```
1 pathname=get_absolute_file_path('1_05.sce')
2 filename=pathname+filesep()+ '1_05data.sci'
3 exec(filename)
4 Ex= (1/E)*(Sx-v*Sy); // x
5 Ey= (1/E)*(Sy-v*Sx); // y
6 G=E/(2*(1+v)); // shear modulus
7 Gxy=Txy/G; // xy
8 printf("\n x : %f",Ex);
9 printf("\n y : %f",Ey);
10 printf("\n G: %f",G);
```

```

11 printf("\n xy : %f",Gxy);
12 PE1=(Ex+Ey)/2 + 0.5*((Ex-Ey)^2 +Gxy^2)^0.5; // I
13 PE2=(Ex+Ey)/2 - 0.5*((Ex-Ey)^2 +Gxy^2)^0.5; // II
14 theta=0.5*atan(Gxy/(Ex-Ey)) *(180/%pi); // in
    degree
15 printf("\n I : %f",PE1);
16 printf("\n II : %f",PE2);
17 printf("\n      : %f degree",theta);
18 printf("\n      : %f degree",theta+90);
19 //plotting mohr circle
20 x=abs((PE1+PE2)/2); //Centre
21 r=(abs(PE1)+abs(PE2))/2; //radius
22 plot2d(0,0,-1,"031", " ",[x- 1.5*r,-1.5*r,x+ 1.5*r
    ,1.5*r]);
23 xgrid(3);
24 xarc(x-r,r,2*r,2*r,0,360*64);
25 x1=[PE1,PE2],y1=[0,0];
26 x2=[Ex,Ey],y2=0.5*[Gxy,-Gxy];
27 theta1=atan(Gxy/(2*Ex)) *(180/%pi);
28 plot(x1,y1);
29 plot(x2,y2);
30 xarc(x-r/4,r/4,r/2,r/2,0,theta1*64);
31 xarc(x-r/2,r/2,r,r,180*64,(180+theta1)*64);
32 datatipToggle();
33 printf("\n\nclick on the point to view its
    coordinate on the plot");
34 xtitle(' Mohr s circle of strain ', ' ', ' ' (
    gamma)', boxed = 1 );

```

---

check Appendix [AP 95](#) for dependency:

1\_07data.sci

Scilab code Exa 1.7 Example 7

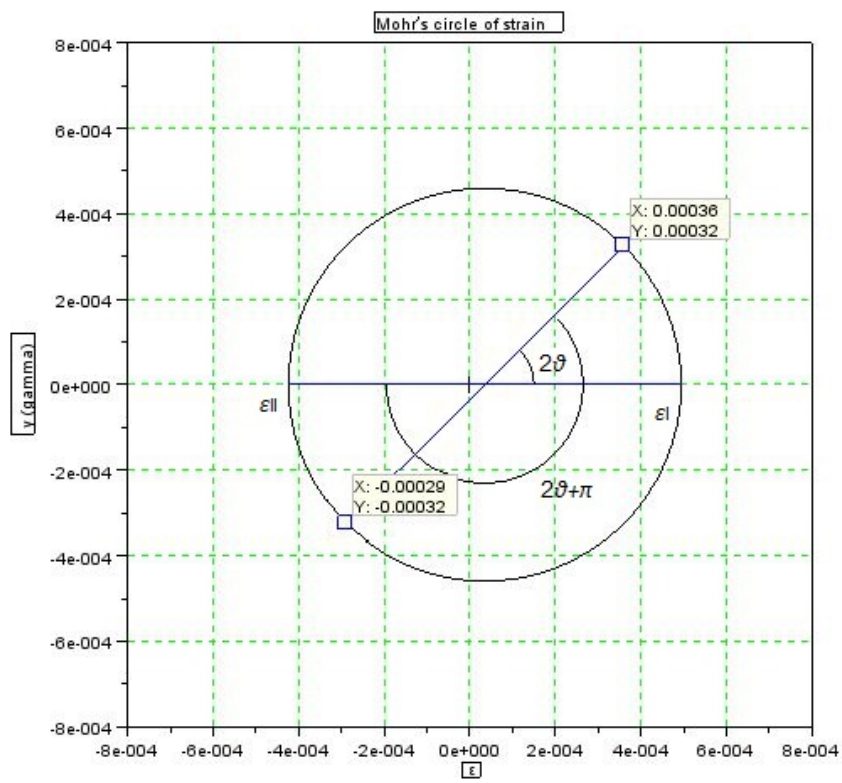


Figure 1.2: Example 5

```

1 pathname=get_absolute_file_path('1_07.sce')
2 filename=pathname+filesep()+ '1_07data.sci'
3 exec(filename)
4 E1=0.5*(Ea+Ec) + (((Ea-Eb)^2 +(Ec-Eb)^2)/2)^0.5;
5 E2=0.5*(Ea+Ec) - (((Ea-Eb)^2 +(Ec-Eb)^2)/2)^0.5;
6 disp(E1," I=" ,E2," II=");
7 S1=E*(E1+ v*E2)/(1-v^2); // I
8 S2=E*(E2+ v*E1)/(1-v^2); // II
9 Sx=S1+S2; // x
10 printf("\n I : %f N/mm^2",S1);
11 printf("\n II : %f N/mm^2",S2);
12 printf("\n x : %f N/mm^2",Sx);
13 P=Sx*(%pi*d^2)/4; //axial tensile load
14 Txy=(((S1-S2)^2 -(S1+S2)^2)/4)^0.5; // xy
15 printf("\n xy : %f N/mm^2",Txy);
16 J=(%pi*d^4)/32; //torsion constant
17 T=2*Txy*J/d; //Torque
18 disp(p/10^3,"P in KN",P,"P(N)=");
19 disp(T/10^6,"T in KN.m",T,"T (N.mm)=");

```

---

# Chapter 3

## Torsion of Solid Section

check Appendix [AP 94](#) for dependency:

3\_1data.sci

Scilab code Exa 3.1 Example 1

```
1 pathname=get_absolute_file_path('3_1.sce')
2 filename=pathname+filesep()+ '3_1data.sci'
3 exec(filename)
4 clear
5 J= (%pi*R^4)/2;
6 x=poly(0,"x");
7 y=poly(0,"y");
8 t= T*R/J; //
9 twistrate= T/(G*J); //rate of twist
10 deff(" [Tzy]=f(x)", "Tzy=T*x/J"); // z y
11 deff(" [Tzx]=f1(y)", "Tzx=-T*y/J"); // z x
12 funcprot(0);
13 function sh=shear(x,y),
14     sh=(T/J)*(x^2 +y^2)^0.5;
15 endfunction
16 t=linspace(-5,5,50);
17 clf();
```

```

18 sh=feval(t,t,shear);
19 plot3d1(t,t,sh);
20 xtitle('STRESS DISTRIBUTION','X','Y',' ');
21 x=[-R:0.01:R];
22 y=[-R:0.01:R];
23 xset('window',1)
24 subplot(2,1,1);
25 fplot2d(x,f);
26 xgrid(3);
27 xtitle('shear stress','-x-','zy');
28 subplot(2,1,2);
29 fplot2d(y,f1,[2]);
30 xgrid(3);
31 xtitle('shear stress','-y-','zx');
32 datatipToggle();
33 printf("\nrate of twist: %f",twistrate);
34 printf("\n n = %f n/mm^2",t);
35 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 93](#) for dependency:

3\_2data.sci

### Scilab code Exa 3.2 Example 2

```

1 pathname=get_absolute_file_path('3_2.sce')
2 filename=pathname+filesep()+ '3_2data.sci'
3 exec(filename)
4 clear
5 J= (%pi*a^3 *b^3)/(a^2 +b^2);
6 twistrate= T/(G*J); //rate of twist

```

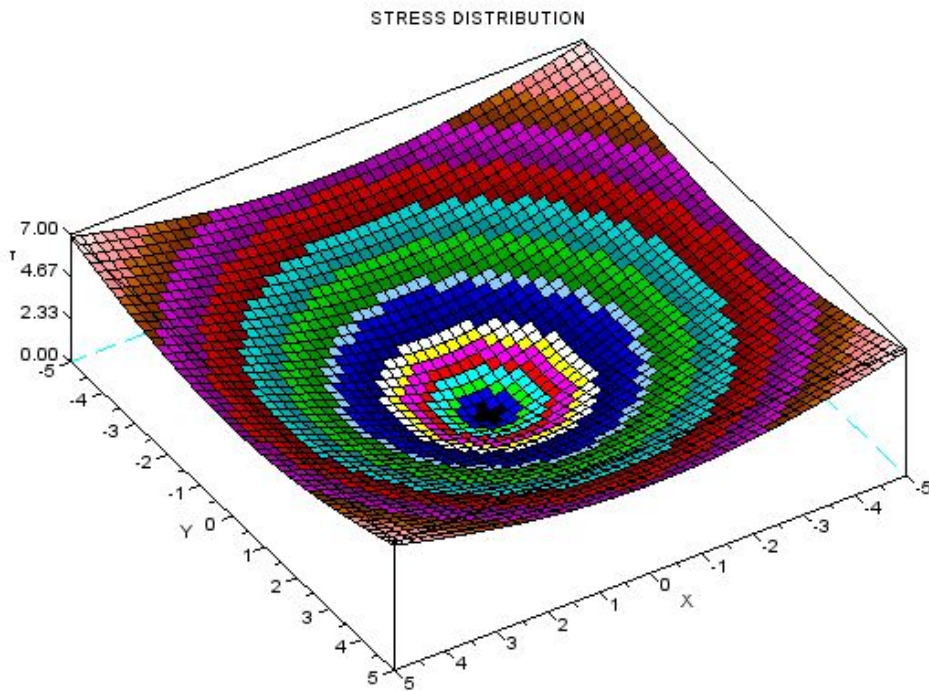


Figure 3.1: Example 1



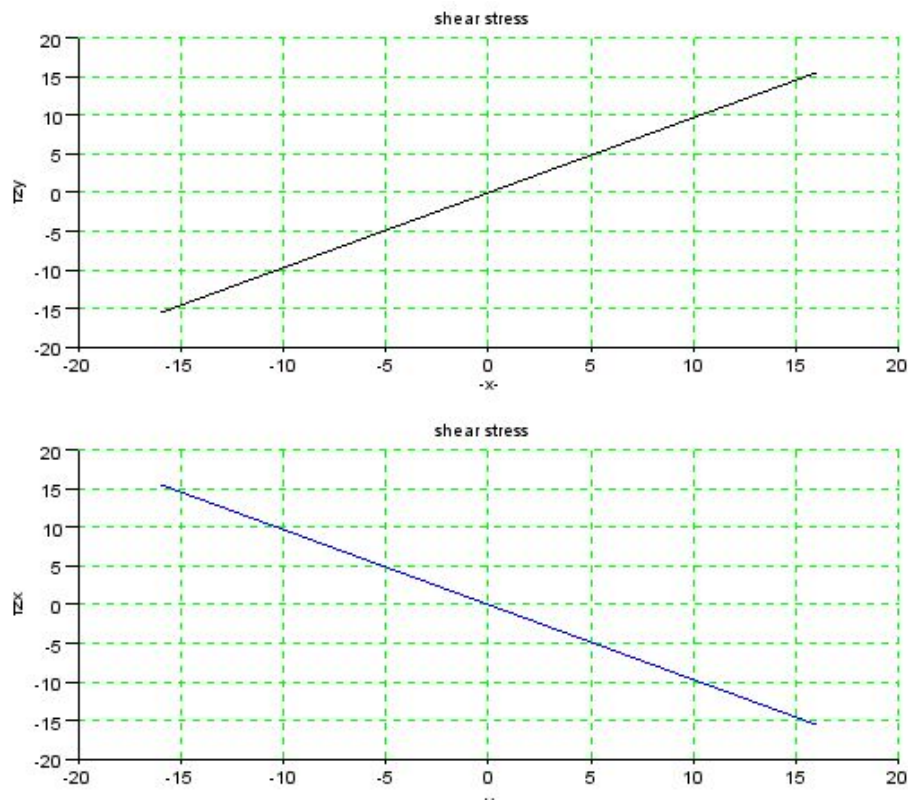


Figure 3.2: Example 1

```

7 x=poly(0,"x");
8 y=poly(0,"y");
9 deff(" [Tzy]=f(x)", "Tzy=2*T*x/(%pi*b*a^3)"); // zy
10 deff(" [Tzx]=f1(y)", "Tzx=-2*T*y/(%pi*a*b^3)"); // zx
11 function w=wrap(x,y),
12     w=((T*(b^2 -a^2))/(%pi*a^3 *b^3 *G))*x*y*1000; //
        warping
13 endfunction
14 t=linspace(-a,a,10*a);
15 clf();
16 w=feval(t,t,wrap);
17 plot3d1(t,t,w);
18 xtitle('wrapping of cross section','x','y','w * 10^3'
        );
19 x=[-a:0.01:a];
20 y=[-b:0.01:b];
21 xset('window',1)
22 subplot(2,1,1);
23 fplot2d(x,f);
24 xgrid(3);
25 xtitle('shear stress', '-x-', 'zy');
26 subplot(2,1,2);
27 fplot2d(y,f1,[2]);
28 xgrid(3);
29 xtitle('shear stress', '-y-', 'zx');
30 datatipToggle();
31 printf("\nrate of twist: %f",twistrate);
32 printf("\n\nclick on the point to view its
        coordinate on the plot");

```

---

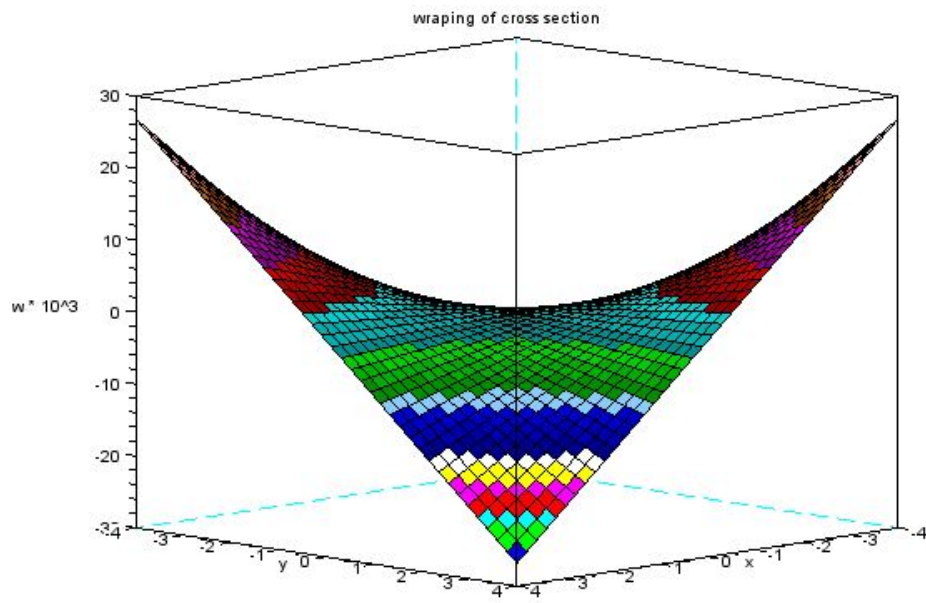


Figure 3.3: Example 2

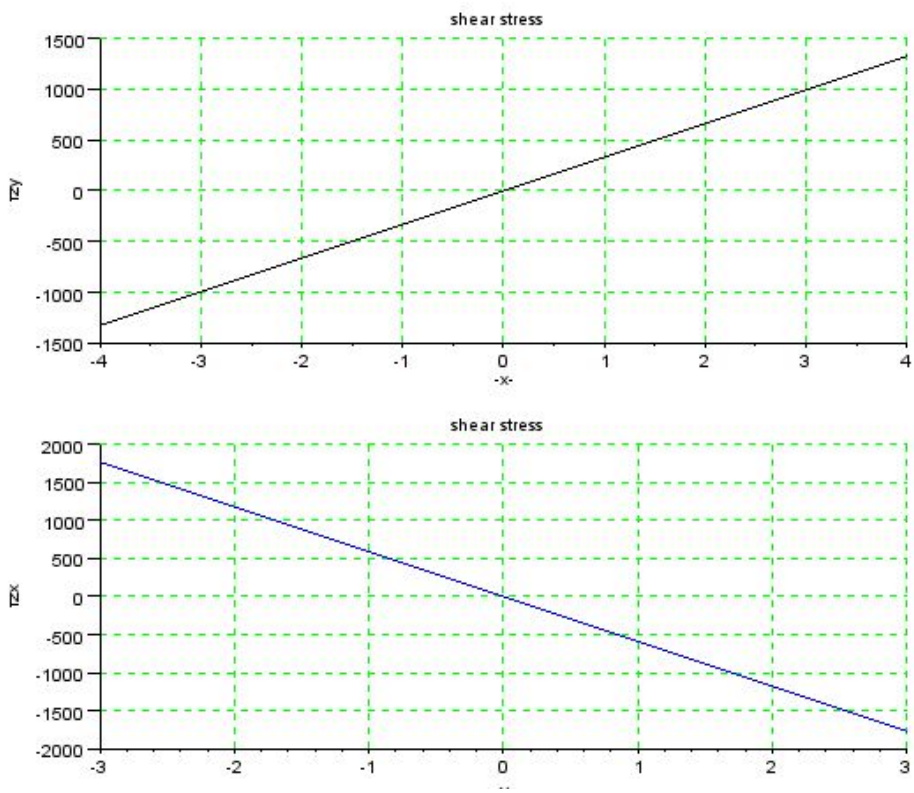


Figure 3.4: Example 2

# Chapter 4

## Virtual work and Energy methods

check Appendix [AP 92](#) for dependency:

```
4_1data.sci
```

Scilab code Exa 4.1 Example 1

```
1 pathname=get_absolute_file_path('4_1.sce')
2 filename=pathname+filesep()+ '4_1data.sci'
3 exec(filename)
4 Ra= W*(L-a)/L;
5 Rb= W*a/L;
6 printf("\\nRA: %f N",Ra);
7 printf("\\nRB: %f N",Rb);
```

---

check Appendix [AP 91](#) for dependency:

```
4_2data.sci
```

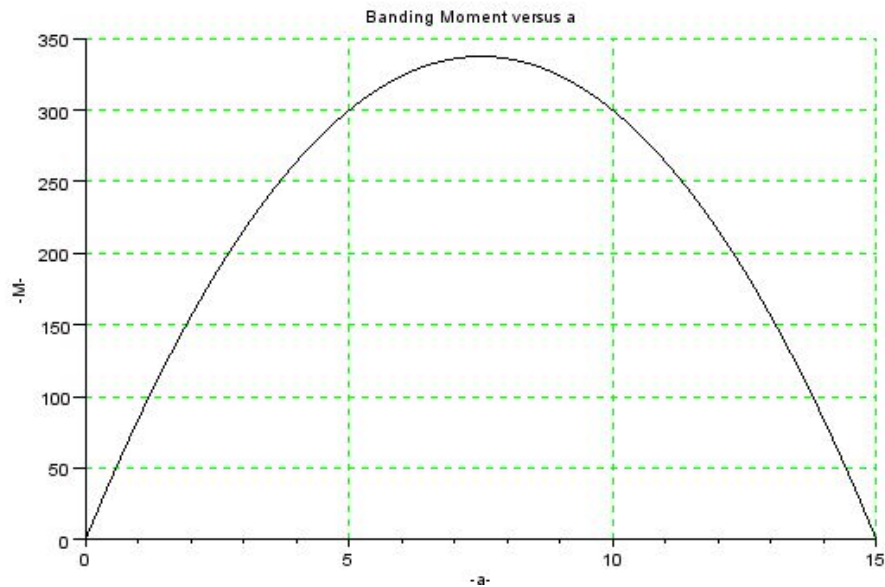


Figure 4.1: Example 2

#### Scilab code Exa 4.2 Example 2

```

1 pathname=get_absolute_file_path('4_2.sce')
2 filename=pathname+filesep()+ '4_2data.sci'
3 exec(filename)
4 M=(W*a*(L-a))/(L);
5 deff("[y]=f(x)", "y=(W*x*(L-x))/(L)") //manding moment
6 x=[0:0.05:L];
7 fplot2d(x,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('Banding Moment versus a', '-a-', '-M-');
11 printf("\nMB: %f N.m",M);
12 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 90](#) for dependency:

4\_3data.sci

### Scilab code Exa 4.3 Example 3

```
1 pathname=get_absolute_file_path('4_3.sce')
2 filename=pathname+filesep()+ '4_3data.sci'
3 exec(filename)
4 Fba=Loadc*(CD/BD); //FBA
5 printf("\nFBA: %f KN",Fba);
```

---

check Appendix [AP 89](#) for dependency:

4\_4data.sci

### Scilab code Exa 4.4 Example 4

```
1 pathname=get_absolute_file_path('4_4.sce')
2 filename=pathname+filesep()+ '4_4data.sci'
3 exec(filename)
4 clear
5 Vb=(w*L^4)/(8*E*I); // B
6 deff("[y]=f(x)", "y= -((w*x^2)/(24*E*I))*(6*L^2 -4*L*
    x +x^2)"); // deflection
7 x=[0:0.05:L];
8 fplot2d(x,f);
9 xgrid(3);
10 datatipToggle();
11 xtitle('vertical deflection versus x', '-x-', '
    vertical deflection');
12 printf("\n B: %f m//",Vb);
13 printf("\n\n click on the point to view its
    coordinate on the plot");
```

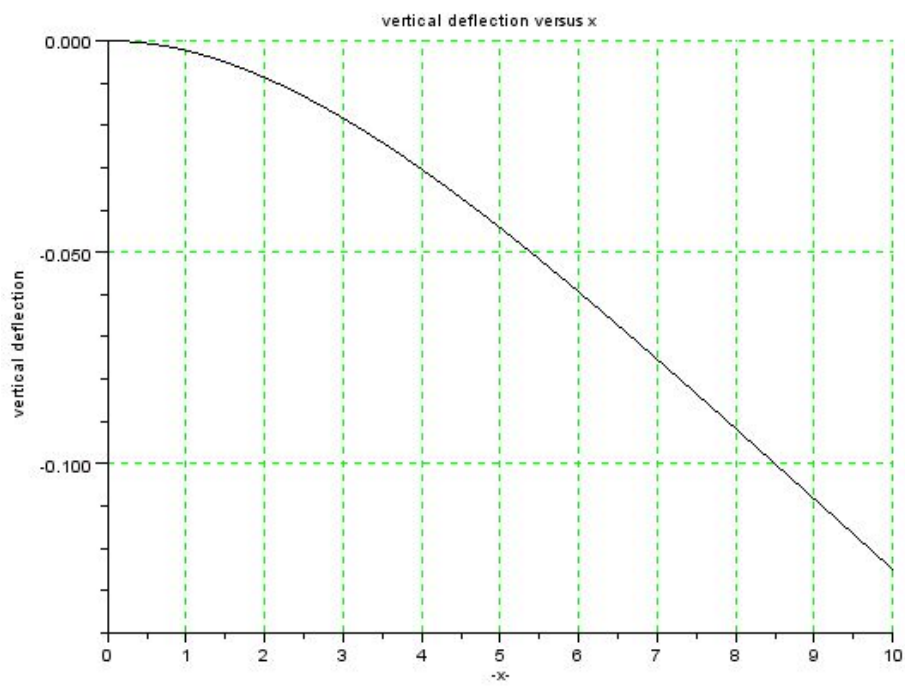


Figure 4.2: Example 4



---

check Appendix [AP 88](#) for dependency:

4\_5data.sci

#### Scilab code Exa 4.5 Example 5

```
1 pathname=get_absolute_file_path('4_5.sce')
2 filename=pathname+filesep()+ '4_5data.sci'
3 exec(filename)
4 clear
5 theta=(W*L^2)/(16*E*I); // A
6 printf("\n A : %f",theta);
```

---

check Appendix [AP 87](#) for dependency:

4\_6data.sci

#### Scilab code Exa 4.6 Example 6

```
1 pathname=get_absolute_file_path('4_6.sce')
2 filename=pathname+filesep()+ '4_6data.sci'
3 exec(filename)
4 L=[(h^2 +AB^2)^0.5;BC;(h^2 +CD^2)^0.5;CD;BC;AB;h;(h
    ^2 +BC^2)^0.5;h]; //column 2
5 A=atan(h/AB),B=atan(h/BC),D=atan(h/CD);
6 lFC=Load2;
7 P=[
8     0 0 sin(D) 0 0 0 0 sin(B);
9     cos(A) 0 0 0 0 1 0 0;
10    cos(A) -1 0 0 0 0 0 0;
11    sin(A) 0 0 0 0 0 1 0;
12    0 0 0 -1 1 0 0 0;
13    0 0 0 0 1 -1 0 cos(B);
```

```

14     0 0 0 0 0 0 1 -sin(B);
15     0 1 -cos(D) 0 0 0 0 cos(B);];
16 X=[-Load2;0;0;-Load1;0;0;Load1;0];
17 D1=[0;0;0;1;1;1;0;0;0]; //F1,D
18 FC=0;
19 P1=[cos(A) 0 0 0 0 1 0 0;
20     0 0 cos(D) 1 0 0 0 0;
21     cos(A) -1 0 0 0 0 0 0;
22     sin(A) 0 0 0 0 0 1 0;
23     0 0 0 -1 1 0 0 0;
24     0 0 0 0 1 -1 0 cos(B);
25     0 0 0 0 0 0 1 sin(B);
26     0 0 1 0 0 0 0 1]
27 X1=[0;0;0;0;0;0;1;0]
28 FA=[inv(P)*X;lFC]; //FA
29 B1=[inv(P1)*X1;FC]; //F1,B
30 for i=1:9
31     K1(i)=FA(i)*B1(i)*L(i); //FA.F1,B.L
32     K2(i)=FA(i)*D1(i)*L(i); //FA.F1,D.L
33 end
34 delB=(sum(K1)*10^3)/(E*CS);
35 delD=(sum(K2)*10^3)/(E*CS);
36 printf("\n B ,v: %f mm",delB);
37 printf("\n D ,h: %f mm",delD);

```

---

# Chapter 5

## Energy Methods

check Appendix [AP 86](#) for dependency:

5\_1data.sci

Scilab code Exa 5.1 Example 1

```
1 pathname=get_absolute_file_path('5_1.sce')
2 filename=pathname+filesep()+ '5_1data.sci'
3 exec(filename)
4 L=[(h^2 +AB^2)^0.5;BC;(h^2 +CD^2)^0.5;CD;BC;AB;h;(h
      ^2 +BC^2)^0.5;h];
5 A=atan(h/AB),B=atan(h/BC),D=atan(h/CD);
6 lFC=Load2;
7 P=[
8     0 0 sin(D) 0 0 0 0 sin(B);
9     cos(A) 0 0 0 0 1 0 0;
10    cos(A) -1 0 0 0 0 0 0;
11    sin(A) 0 0 0 0 0 1 0;
12    0 0 0 -1 1 0 0 0;
13    0 0 0 0 1 -1 0 cos(B);
14    0 0 0 0 0 0 1 -sin(B);
15    0 1 -cos(D) 0 0 0 0 cos(B)];
16 X=[-Load2;0;0;-Load1;0;0;Load1;0];
```

```

17 D1=[0;0;0;1;1;1;0;0;0];
18 FC=0;
19 P1=[cos(A) 0 0 0 0 1 0 0;
20      0 0 cos(D) 1 0 0 0 0;
21      cos(A) -1 0 0 0 0 0 0;
22      sin(A) 0 0 0 0 0 1 0;
23      0 0 0 -1 1 0 0 0;
24      0 0 0 0 1 -1 0 cos(B);
25      0 0 0 0 0 0 1 sin(B);
26      0 0 1 0 0 0 0 1]
27 X1=[0;0;0;0;0;0;0;1;0]
28 FA=[inv(P)*X;1FC];
29 B1=[inv(P1)*X1;FC];
30 for i=1:9
31     K1(i)=FA(i)*B1(i)*L(i);
32     K2(i)=FA(i)*D1(i)*L(i);
33 end
34 delB=(sum(K1)*10^3)/(E*CS);
35 delD=(sum(K2)*10^3)/(E*CS);
36 printf("\n B ,v: %f mm",delB);
37 printf("\n D ,h: %f mm",delD);

```

---

check Appendix [AP 82](#) for dependency:

5\_2data.sci

### Scilab code Exa 5.2 Example 2

```

1 pathname=get_absolute_file_path('5_2.sce')
2 filename=pathname+filesep()+ '5_2data.sci '
3 exec(filename)
4 delB=(119*w*L^4)/(24576*EI);
5 delC=(5*w*L^4)/(384*EI);
6 printf("\ndelB: %f m",delB);
7 printf("\ndelC: %f m",delC);

```

---

check Appendix [AP 81](#) for dependency:

5\_3data.sci

### Scilab code Exa 5.3 Example 3

```
1 pathname=get_absolute_file_path('5_3.sce')
2 filename=pathname+filesep()+ '5_3data.sci'
3 exec(filename)
4 clear
5 L1=[L*tan(theta);L;L*tan(theta);L;L];
6 A=[AC;A;AC;A;A];
7 F1=[Load*cos(theta);Load*sin(theta);0;0;0];
8 F2=[-sin(theta);cos(theta);-sin(theta);1;cos(theta)
    ];
9 for i=1:5
10     X(i)=L1(i)/A(i);
11     X1(i)=F1(i)*F2(i)*X(i);
12     X2(i)=F2(i)*F2(i)*X(i);
13 end
14 R=-sum(X1)/sum(X2);
15 F=F1+ R*F2;
16 disp(" Force (AC, CB, BD, CD, AD) :");
17 printf("\n %f N", F);
```

---

check Appendix [AP 80](#) for dependency:

5\_4data.sci

### Scilab code Exa 5.4 Example 4

```
1 pathname=get_absolute_file_path('5_4.sce')
2 filename=pathname+filesep()+ '5_4data.sci'
3 exec(filename)
```

```

4 clear
5 AC=(AB^2 +BC^2)^0.5;
6 delBC=BC*delT*alpha;
7 F1=[AB/BC;1;AB/BC;1;-AC/BC;-AC/BC];
8 L=[AB;BC;AB;BC;AC;AC];
9 for i=1:6
10     X(i)=L(i)*F1(i)*F1(i);
11 end
12 R=(-delBC*A*E)/sum(X);
13 F=R*F1;
14 disp(" Force (AB,BC,CD,DA,AC,DB) :");
15 printf("\n %f N",F);

```

---

check Appendix [AP 79](#) for dependency:

5\_5data.sci

### Scilab code Exa 5.5 Example 5

```

1 pathname=get_absolute_file_path('5_5.sce')
2 filename=pathname+filesep()+ '5_5data.sci'
3 exec(filename)
4 clear
5 L1=0.5*L*ones(7,1);
6 A1=[Ab;Ab;A;A;A;A;A];
7 R=(11*3^0.5 *P*A*Ab*L^2)/(48*(L*L*A*Ab + 4*I*(A+ 10*
    Ab)));
8 delF=[-cos(theta);-cos(theta);1;1;-1;-1;1];
9 F=R*delF;
10 disp(R,"R:");
11 disp(" Force (AB,BC,CD,DE,BD,EB,AE) :");
12 printf("\n %f N",F)

```

---

check Appendix [AP 78](#) for dependency:

5\_6data.sci

### Scilab code Exa 5.6 Example 6

```
1 pathname=get_absolute_file_path('5_6.sce')
2 filename=pathname+filesep()+ '5_6data.sci'
3 exec(filename)
4 SA=0.187*M0/r;
5 SB=0.44*M0/r;
6 SC=0.373*M0/r;
7 printf("\nSA: %f N ",SA)
8 printf("\nSB: %f N",SB)
9 printf("\nSC:%f N",SC)
10 printf("\nM1: %f N.mm",SA*r)
11 printf("\nM2: %f N.mm",SB*r)
12 printf("\nM3: %f N.mm",SC*r)
```

---

check Appendix [AP 77](#) for dependency:

5\_7data.sci

### Scilab code Exa 5.7 Example 7

```
1 pathname=get_absolute_file_path('5_7.sce')
2 filename=pathname+filesep()+ '5_7data.sci'
3 exec(filename)
4 clear
5 delY=(W*L^4)*((11/(24*EI))+ 1/(2*GJ));
6 delZ=(W*L^4)*((1/(6*EI))+ 1/(2*GJ));
7 printf("\ndel Y %f mm",delY);
8 printf("\ndel Z %f mm",delZ);
```

---

check Appendix [AP 76](#) for dependency:

5\_8data.sci

### Scilab code Exa 5.8 Example 8

```
1 pathname=get_absolute_file_path('5_8.sce')
2 filename=pathname+filesep()+ '5_8data.sci'
3 exec(filename)
4 L1=[L;L;L;1.41*L;1.41*L;L];
5 F0=[0 0 -P 0 1.41*P 0];
6 F1=[-0.71;-0.71;-0.71;1;1;-0.71];
7 for i=1:6
8     X(i)=F0(i)*F1(i)*L1(i);
9     X1(i)=F1(i)*F1(i)*L1(i);
10 end
11 XBD= -sum(X)/sum(X1);
12 Fa=[-XBD/1.41;-XBD/1.41;((XBD/1.41)+1);XBD;-(((XBD
    /1.41)+1))*1.41;-XBD/1.41];
13 disp("Forces in the Mambrane are:");
14 printf("\n %f N",Fa)
```

---

check Appendix [AP 75](#) for dependency:

5\_9data.sci

### Scilab code Exa 5.9 Example 9

```
1 pathname=get_absolute_file_path('5_9.sce')
2 filename=pathname+filesep()+ '5_9data.sci'
3 exec(filename)
4 M=2^0.5;
5 L1=[L;M*L;L;L;M*L;M*L;L];
6 F0=[P;0;0;0;0;-M*P;0];
7 F1=[-0.71;0;0;-0.71;1;1;-0.71];
8 F1R2=[-2;-M;1;1;0;M;0];
```



```

9  for i=1:7
10     X(i)=F0(i)*F1(i)*L1(i);
11     X1(i)=F0(i)*F1R2(i)*L1(i);
12     X2(i)=F1(i)*F1(i)*L1(i);
13     X3(i)=F1R2(i)*F1R2(i)*L1(i);
14     X4(i)=F1(i)*F1R2(i)*L1(i);
15  end
16  X5=[sum(X2) sum(X4);
17      sum(X4) sum(X3)];
18  X6=-[sum(X);sum(X1)]
19  X7=inv(X5)*X6;
20  printf("\nX1: %f KN",X7(1,:));
21  printf("\nR2: %f KN",X7(2,:))
22  Fa=[X7(1,:)*M-X7(2,:)*(1+(1/M));-X7(2,:)*M;X7(2,:);
      X7(2,:)-X7(1,:)/M;X7(1,:);-X7(2,:)*(1+(1/M));-X7
      (1,:)/M]
23  disp(" Forces in the Mambrane are:");
24  printf("\n %f KN",Fa);

```

---

check Appendix [AP 85](#) for dependency:

5\_10data.sci

### Scilab code Exa 5.10 Example 10

```

1  pathname=get_absolute_file_path('5_10.sce')
2  filename=pathname+filesep()+ '5_10data.sci'
3  exec(filename)
4  c=((a*a +b*b)^0.5);
5  L=[a;b;a;b;(a*a +b*b)^0.5;(a*a +b*b)^0.5];
6  F1=[a/b;1;a/b;1;-c/b;-c/b]
7  for i=1:6
8     X(i)=F1(i)*F1(i)*L(i);
9  end
10  a11=sum(X)/(A*E);
11  X1=-alpha*b*T/a11;

```

```

12 Fa=[X1*a/b;X1;X1*a/b;X1;-X1*c/b;-X1*c/b]
13 printf("\nX1: %f N",X1);
14 disp("Forces in the Mambrane are (AB,BC,CD,DA,AC,DB)
      :");
15 printf("\n %f KN",Fa);

```

---

check Appendix [AP 84](#) for dependency:

5\_11data.sci

### Scilab code Exa 5.11 Example 11

```

1 pathname=get_absolute_file_path('5_11.sce')
2 filename=pathname+filesep()+ '5_11data.sci'
3 exec(filename)
4 VB=(W*L^3)/(48*EI);
5 printf("\nVB: %f m",VB);

```

---

check Appendix [AP 83](#) for dependency:

5\_12data.sci

### Scilab code Exa 5.12 Example 12

```

1 pathname=get_absolute_file_path('5_12.sce')
2 filename=pathname+filesep()+ '5_12data.sci'
3 exec(filename)
4 v1= (L1/L0)*V(3);
5 v2= (L2/L0)*V(4);
6 v3= v1+v2;
7 theta=atan(v3/(D(9)-D(6)));
8 printf("\n B: %f rad",theta);

```

---

# Chapter 6

## Matrix Methods

check Appendix [AP 74](#) for dependency:

6\_1data.sci

Scilab code Exa 6.1 Example 1

```
1 pathname=get_absolute_file_path('6_1.sce')
2 filename=pathname+filesep()+ '6_1data.sci'
3 exec(filename)
4 //theta= ,lambda= ,mu=
5 theta12=0,lambda12=cos(theta12),mu12=sin(theta12);
6 theta13=%pi/2,lambda13=cos(theta13),mu13=sin(theta13
   );
7 theta23=%pi/2 + atan(L13/L12);lambda23=cos(theta23),
   mu23=sin(theta23);
8 L23=(L12^2 +L13^2)^0.5;
9 LL12=lambda12^2,LM12=lambda12*mu12,MM12=mu12^2;
10 LL13=lambda13^2,LM13=lambda13*mu13,MM13=mu13^2;
11 LL23=lambda23^2,LM23=lambda23*mu23,MM23=mu23^2;
12 K220=[LL12 LM12;LM12 MM12];
13 K222=(L12/L23)*[LL23 LM23;LM23 MM23];
```

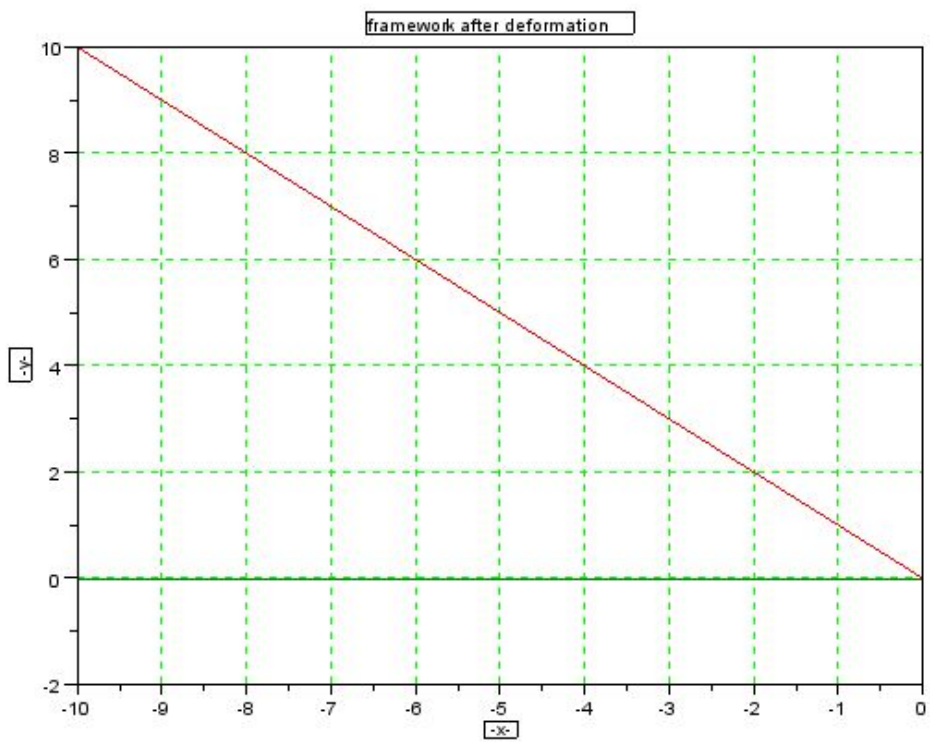


Figure 6.1: Example 1

```

14 K210=[-LL12 -LM12;-LM12 -MM12];
15 K232=(L12/L23)*[-LL23 -LM23;-LM23 -MM23];
16 K=K220+K222;
17 F=[FX2;FY2];
18 V=(L12/AE)*inv(K)*F;
19 u2=V(1,:),v2=V(2,:);
20 u1=0;v1=0;u3=0;v3=0;
21 F1=[K210';K232']*inv(K)*F;
22 S12=(AE/L12)*[lambda12 mu12]*[u2-u1;v2-v1];
23 S13=(AE/L13)*[lambda13 mu13]*[u3-u1;v3-v1];
24 S23=(AE/L23)*[lambda23 mu23]*[u3-u2;v3-v2];
25 x1=[-L12,-L12],y1=[0,L13];
26 x2=[-L12,u2],y2=[0,v2];
27 x3=[-L12,u2],y3=[L13,v2];
28 plot(x1,y1,x2,y2,x3,y3);
29 xgrid(3);
30 datatipToggle();
31 xtitle('framework after deformation','-x-','-y
    -',boxed = 1);
32 printf("\n\nu2: %f m",u2);
33 printf("\nv2: %f m",v2);
34 printf("\nFx,1: %f N",F1(1,:));
35 printf("\nFy,1: %f N",F1(2,:));
36 printf("\nFx,3: %f N",F1(3,:));
37 printf("\nFy,3: %f N",F1(4,:));
38 printf("\nS12: %f N",S12);
39 printf("\nS13: %f N",S13);
40 printf("\nS23: %f N",S23);
41 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 73](#) for dependency:

6\_2data.sci

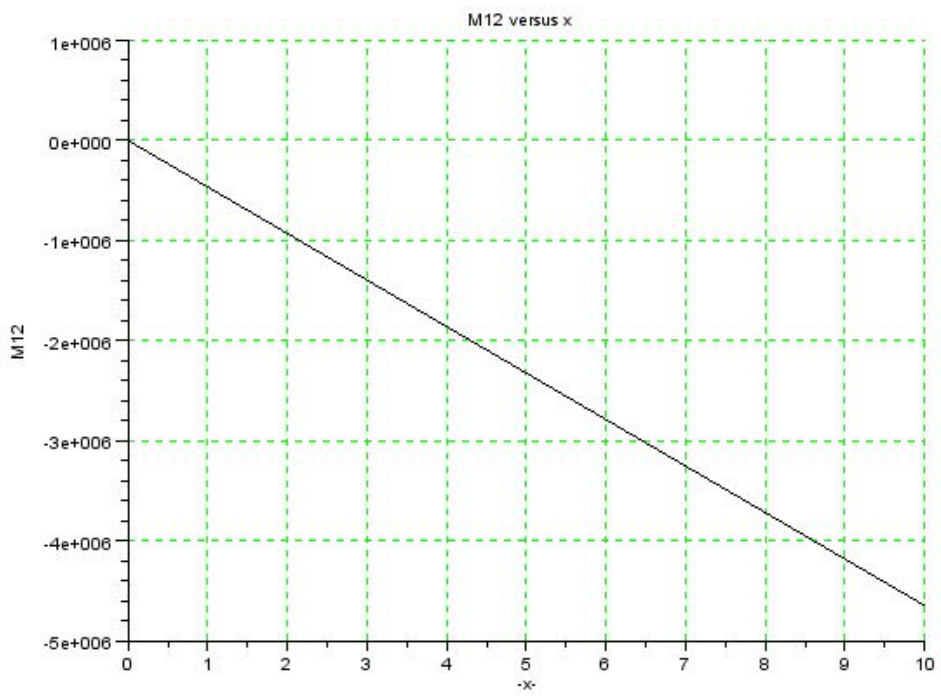


Figure 6.2: Example 2

### Scilab code Exa 6.2 Example 2

```
1 pathname=get_absolute_file_path('6_2.sce')
2 filename=pathname+filesep()+ '6_2data.sci'
3 exec(filename)
4 F=[-W;M;0;0];
5 P=EI*[(27/(2*L^3)) (9/(2*L^2)) (6/L^2) -(3/(2*L^2))];
6     (9/(2*L^2)) (6/L) (2/L) (1/L);
7     (6/L^2) (2/L) (4/L) 0;
8     -(3/(2*L^2)) (1/L) 0 (2/L)];
9 V=inv(P)*F;
10 Sy12= EI*(-(6*V(3)/(L^2))-(12*V(1)/(L^3)) -(6*V(2)/(L*L))); //Sy,12
11 defm(" [M12]=f(x)", "M12=EI*((( -6*x/L*L)+(4/L))*V(3) +
    ((-12*x/L^3)+(6/L^2))*V(1) +((-6*x/L*L)+(2/L))*V
    (2))");
12 x=[0:0.05:L];
13 fplot2d(x,f);
14 xgrid(3);
15 xtitle('M12 versus x', '-x-', 'M12');
16 datatipToggle();
17 printf("\n 2: %f m",V(1)); //v2
18 printf("\n 2: %f ",V(2)); // 2
19 printf("\n 2: %f ",V(3)); // 1
20 printf("\n 2: %f ",V(4)); // 3
21 printf("\nSy,12: %f",Sy12); //Sy,12
```

---

check Appendix [AP 72](#) for dependency:

6\_4data.sci

### Scilab code Exa 6.4 Example 4

```
1 pathname=get_absolute_file_path('6_4.sce')
2 filename=pathname+filesep()+ '6_4data.sci'
3 exec(filename)
```

```

4 P=[1 P1(1) P1(2) P1(1)*P1(2);
5     1 P2(1) P2(2) P2(1)*P2(2);
6     1 P3(1) P3(2) P3(1)*P3(2);
7     1 P4(1) P4(2) P4(1)*P4(2)];
8 alpha1=inv(P)*u;
9 alpha2=inv(P)*v;
10 alpha=[alpha1;alpha2];
11 deff(" [Ex]=f(y)", "Ex=alpha(2)+ y*alpha(4)"); // x
12 deff(" [Ey]=f1(x)", "Ey=alpha(7)+ x*alpha(8)"); // y
13 function [G]=Gxy(x,y) // xy
14     G=x*alpha(4) +y*alpha(8) +alpha(3)+alpha(6);
15 endfunction
16 //at the centre
17 Pc(1)=(P1(1)+P3(1))/2;
18 Pc(2)=(P1(2)+P3(2))/2;
19 Sy=(E/(1-V^2))*(f1(Pc(2)) +V*f(Pc(1)));
20 Sx=(E/(1-V^2))*(f(Pc(1)) +V*f1(Pc(2)));
21 gxy=Gxy(0,0);
22 txy=(E/(1-V^2))*0.5*(1-V)*gxy; // xy
23 printf("\n x : %f N/mm^2",Sx);
24 printf("\n y : %f N/mm^2",Sy);
25 printf("\n xy : %f N/mm^2",txy);

```

---



# Chapter 7

## Bending of Thin plates

check Appendix [AP 71](#) for dependency:

7\_1data.sci

Scilab code Exa 7.1 Example 1

```
1 pathname=get_absolute_file_path('7_1.sce')
2 filename=pathname+filesep()+ '7_1data.sci'
3 exec(filename)
4 D=(E*t^3)/(12*(1-v^2));
5 X=(16*q0/(D*pi^6))/(((1/a^2)+(1/b^2))^2);
6 X1=(16*q0/pi^4)*((1/a^2)+(v/b^2))/(((1/a^2)+(1/b^2)
7   )^2);
8 X2=(16*q0/pi^4)*((v/a^2)+(1/b^2))/(((1/a^2)+(1/b^2)
9   )^2);
10 function [w]=f(x,y), //taking first term only
11     w=X*(sin(%pi*x/a))*sin(%pi*y/b);
12 endfunction
13 x=linspace(0,a,10*a);
14 y=linspace(0,b,10*b);
15 w=feval(x,y,f);
```

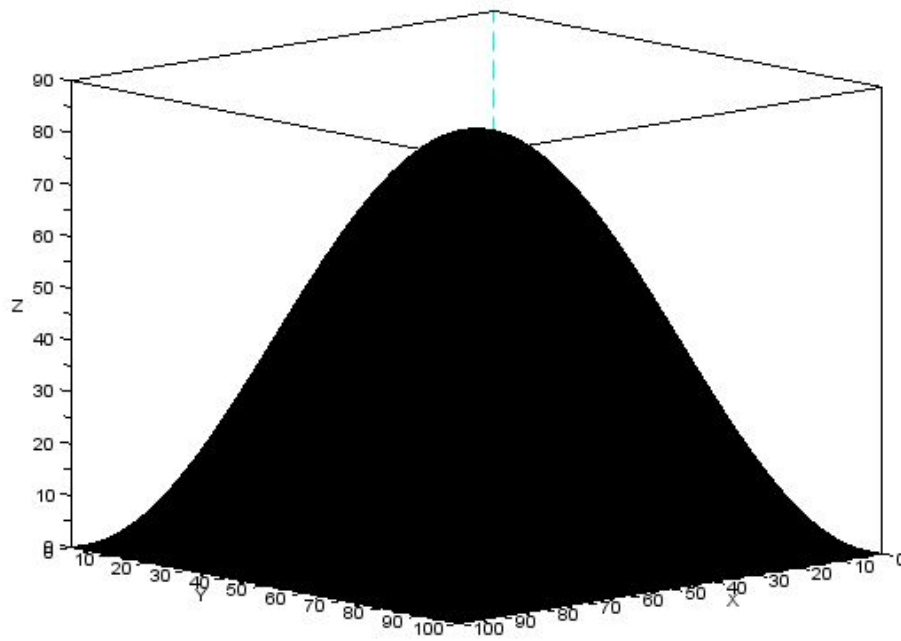


Figure 7.1: Example 1

```

14 plot3d1(x,y,w);
15 Wmax=(0.0443*q0*a^4)/(E*t^3); //from summation of
    first 4 terms
16 printf("\nWmax: %f mm",Wmax);
17 function [Mx,My]=f1(x,y) //taking first term only
18     Mx=X1*(sin(%pi*x/a))*sin(%pi*y/b);
19     My=X2*(sin(%pi*x/a))*sin(%pi*y/b);
20 endfunction
21 function [Sx,Sy]=f2(x,y,z) //taking first term only
22     Sx=12*X1*(sin(%pi*x/a))*sin(%pi*y/b)*z/t^3;
23     Sy=12*X2*(sin(%pi*x/a))*sin(%pi*y/b)*z/t^3;
24 endfunction
25 Mxmax=0.0479*q0*a^2; //from summation of first 5
    terms
26 printf("\nMx,max= My,max= %f N.mm",Mxmzx);
27 Sxmax=(0.287*q0*a^2)/t^2;
28 printf("\n x ,max= y ,max= %f N.mm",Sxmax);

```

---

check Appendix [AP 70](#) for dependency:

7\_3data.sci

### Scilab code Exa 7.3 Example 3

```

1 pathname=get_absolute_file_path('7_3.sce')
2 filename=pathname+filesep()+ '7_3data.sci '
3 exec(filename)
4 D=(E*t^3)/(12*(1-v^2));
5 X=(16*q0/(D*pi^6))/((((1/a^2)+(1/b^2))^2)+(Nx/(D*a*
    a*pi^2)));
6 function [w]=f(x,y) //taking first term only
7     w=X*(sin(%pi*x/a))*sin(%pi*y/b);
8 endfunction
9 x=linspace(0,a,10*a);

```

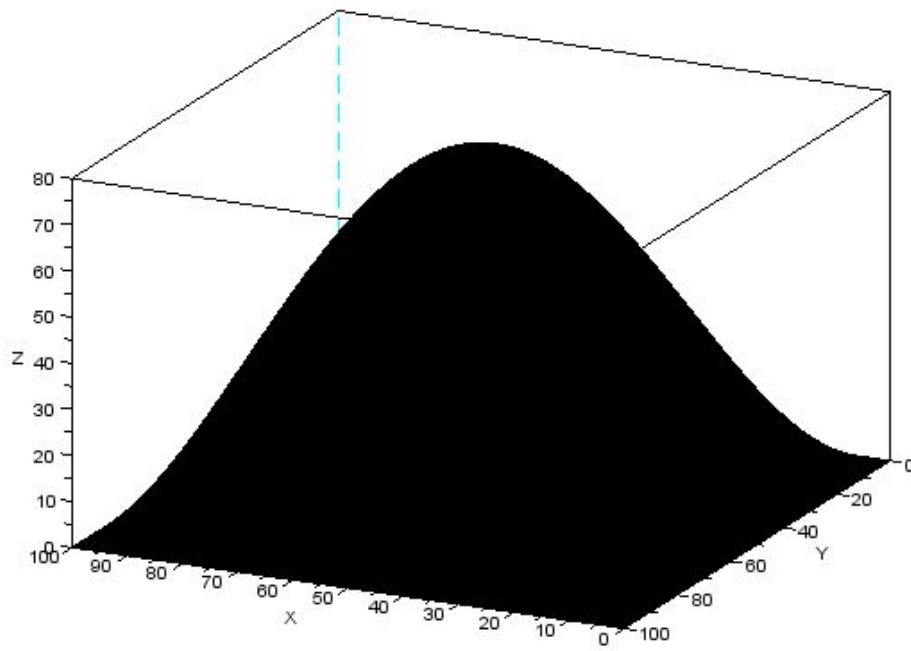


Figure 7.2: Example 3

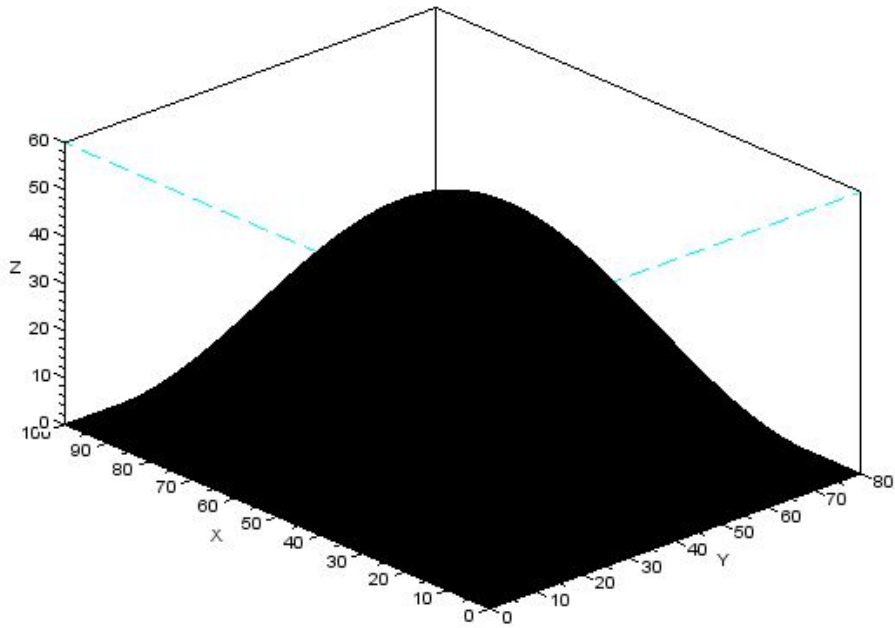


Figure 7.3: Example 4

```

10 y=linspace(0,b,10*b);
11 w=feval(x,y,f);
12 plot3d1(x,y,w);
13 datatipToggle();
14 printf("\n click on the point to view its coordinate
    on the plot")

```

---

check Appendix [AP 69](#) for dependency:

7\_4data.sci

**Scilab code Exa 7.4 Example 4**

```

1 pathname=get_absolute_file_path('7_4.sce')

```

```

2 filename=pathname+filesep()+ '7_4data.sci '
3 exec(filename)
4 clear
5 D=(E*t^3)/(12*(1-v^3));
6 A11= (16*q0*(a^4)*(b^4))/((%pi^6)*D*((a*a +b*b)^2));
7 function [w]=f(x,y)
8     w=A11*(sin(%pi*x/a))*(sin(%pi*y/b));
9 endfunction
10 funcprot()
11 x=linspace(0,a,10*a);
12 y=linspace(0,b,10*b);
13 clf();
14 w=feval(x,y,f);
15 plot3d1(x,y,w);
16 datatipToggle()
17 printf("\nA11= Wmax: %f mm",f(a/2,b/2));

```

---

# Chapter 8

## Columns

check Appendix [AP 68](#) for dependency:

8\_2data.sci

Scilab code Exa 8.2 Example 2

```
1 pathname=get_absolute_file_path('8_2.sce')
2 filename=pathname+filesep()+ '8_2data.sci'
3 exec(filename)
4 mu=(P/(E*I))^0.5; //
5 deff("[v]=f(z)", "v=e*((cos(mu*(z-L/2)))/cos(mu*L/2))
    -1"); //v
6 deff("[m]=f1(z)", "m=P*(e+e*((cos(mu*(z-L/2)))/cos(mu*
    L/2))-1)"); //M
7 funcprot(0);
8 z=[0:0.05:L];
9 subplot(2,1,1);
10 fplot2d(z,f);
11 xgrid(3);
12 xtitle('deflection', '-z-', '-v-');
13 subplot(2,1,2);
```

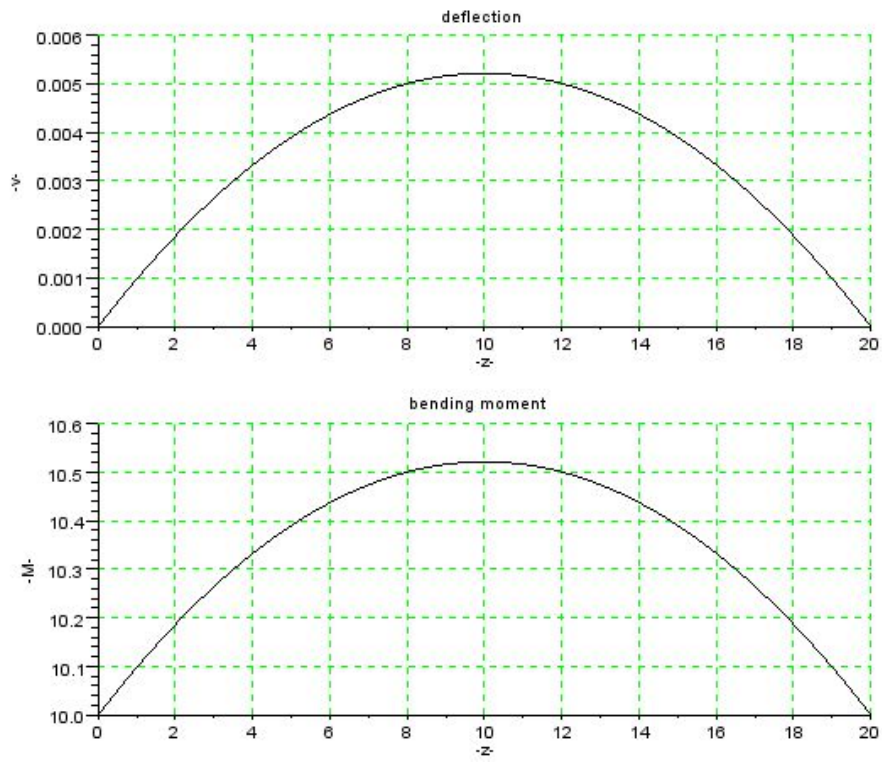


Figure 8.1: Example 2



```

14 fplot2d(z, f1);
15 xgrid(3);
16 xtitle( 'bending moment', ' -z- ', ' -M- ');
17 datatipToggle();
18 printf("\nmaximum deflection: %f", f(L/2));
19 printf("\nM(max)= %f N.m", f1(L/2));

```

---

check Appendix [AP 67](#) for dependency:

8\_3data.sci

### Scilab code Exa 8.3 Example 3

```

1 pathname=get_absolute_file_path('8_3.sce')
2 filename=pathname+filesep()+ '8_3data.sci'
3 exec(filename)
4 A=t*(2*a +b);
5 Ixx=2*a*t*(b/2)^2 +(t*b^3)/12;
6 Iyy=(2*t*a^3)/12;
7 I0=Ixx+Iyy;
8 J=(2*a*t^3)/3 +(b*t^3)/3;
9 tau=(t*a^3 *b^2)/24;
10 Px=(%pi^2 *E*Ixx/L^2); //PCR(xx)
11 Py=(%pi^2 *E*Iyy/L^2); //PCR(yy)
12 Pth=(A/I0)*(G*J +( %pi^2 *E*tau)/L^2); //PCR( )
13 P=poly(0, 'P');
14 y=(I0/A)*(P^2 -(Px +Pth)*P +Px*Pth);
15 m=roots(y);
16 Ptb1=m(1, :)
17 Ptb2=m(2, :)
18 Load=[Px;Py;Pth];
19 printf("\nbuckling Load: %f N", min(Load));
20 printf("\nflexural-torsional buckling Load: %f N",
    roots(y));

```

---

check Appendix [AP 66](#) for dependency:

8\_4data.sci

#### Scilab code Exa 8.4 Example 4

```
1 pathname=get_absolute_file_path('8_4.sce')
2 filename=pathname+filesep()+ '8_4data.sci'
3 exec(filename)
4 clear
5 Xc=(a2^2)/(b+ 2*a2); //x bar
6 Xs=-(Xc+((3*a2^2)/(b*(1+ 6*a2/b))));
7 A= 2*a2*t + b*t;
8 Ixx=2*a2*t*(b/2)^2 +(t*b^3)/12;
9 Iyy=b*t*Xc^2 +(2*t/3)*((a2-Xc)^3 +Xc^3);
10 I0=Ixx+Iyy+ A*Xs^2;
11 J=(2*a2*t^3)/3 +(b*t^3)/3;
12 tau= 0.1244*t*a2^3 *b^2;
13 Px=((%pi^2)*E*Ixx/(L^2)); //PCR(xx)
14 Py=((%pi^2)*E*Iyy/(L^2)); //PCR(yy)
15 Pth=(A/I0)*(G*J +((%pi^2)*E*tau)/(L^2)); //PCR( )
16 a=(1-(A*Xs^2)/I0),b=-(Px +Pth),c=Px*Pth;
17 P1=(-b +(b*b -4*a*c)^0.5)/(2*a);
18 P2=(-b -(b*b -4*a*c)^0.5)/(2*a);
19 Load=[Px;Py;Pth;P1;P2];
20 minimum=Load(1);
21 for i=2:5
22     if(Load(i)<Load(i-1)) then
23         minimum=Load(i);
24         a1=i;
25     end
26 end
27 if(a1>3) then
28     printf("\nflexural-torsional buckling will
29         happen.\nand buckling load is: %f N",minimum)
30     ;
31 else
```

```
30     printf("\nuncoupled buckling will happen\nand
        buckling Load is %f N",minimum);
31 end
```

---

# Chapter 9

## Thin plates

check Appendix [AP 65](#) for dependency:

9\_1data.sci

Scilab code Exa 9.1 Example 1

```
1 pathname=get_absolute_file_path('9_1.sce')
2 filename=pathname+filesep()+ '9_1data.sci '
3 exec(filename)
4 alpha= atan(((1+ t*d/(2*Af))/(1+ t*b/As))^0.25); //
5 Ft=(W*z/d)+(W/(2*tan(alpha))); //FT
6 printf("\nFT: %f N",Ft);
7 Mmax= (W*tan(alpha)*b^2)/(12*d);
8 Smax= (Mmax/ESM)+(Ft/Af); // max
9 printf("\nMaximum Stress in Flange: %f N/mm^2",Smax)
;
10 P=(W*b*tan(alpha))/d;
11 if(b<1.5*d) then //le
12     Le=d/((4-(2*b/d))^0.5);
13 else
14     Le=d;
15 end
16 Pcr= ((%pi^2)*E*I)/(Le^2);
```

```
17 printf("\nPcr: %f KN",Pcr);
18 printf("\nP: %f KN",P);
19 if(P<Pcr) then
20     printf("\nstiffener will not buckle")
21 else
22     printf("\nstiffener will buckle")
23 end
```

---

# Chapter 10

## Oscillation of mass spring systems

check Appendix [AP 64](#) for dependency:

```
10_1data.sci
```

Scilab code Exa 10.1 Example 1

```
1 pathname=get_absolute_file_path('10_1.sce')
2 filename=pathname+filesep()+ '10_1data.sci'
3 exec(filename)
4 lambda=(m*l^3)/(3*48*EI); //
5 x=poly(0, 'x');
6 y=21*x^2 -22*x +1;
7 m=roots(y);
8 omega1=(m(1, :)/lambda)^0.5; // 1
9 omega2=(m(1, :)/lambda)^0.5; // 2
10 f1=omega1/(2*%pi);
11 f2=omega2/(2*%pi);
12 printf(" \nf1 :%f", f1);
13 printf(" \nf2 :%f", f2);
```

---

check Appendix [AP 63](#) for dependency:

10\_2data.sci

### Scilab code Exa 10.2 Example 2

```
1 pathname=get_absolute_file_path('10_2.sce')
2 filename=pathname+filesep()+ '10_2data.sci'
3 exec(filename)
4 lambda=(m*l^3)/(6*EI); //
5 a=188, b=-44, c=1
6 m1=(-b+(b*b -4*a*c)^0.5)/(2*a);
7 m2=(-b-(b*b -4*a*c)^0.5)/(2*a);
8 omega1=(m1/lambda)^0.5; // 1
9 omega2=(m2/lambda)^0.5; // 2
10 f1=[omega1;omega2];
11 f=min(f1)/(2*%pi);
12 printf("\nlowest natural frequency is: %f",f);
```

---

check Appendix [AP 62](#) for dependency:

10\_4data.sci

### Scilab code Exa 10.4 Example 4

```
1 pathname=get_absolute_file_path('10_4.sce')
2 filename=pathname+filesep()+ '10_4data.sci'
3 exec(filename)
4 for i=1:3
5     f(i)=(0.5*%pi*i/L)*(EI/(rho*A))^0.5;
6 end
7 printf("\nf1: %f",f(1));
8 printf("\nf2: %f",f(2));
9 printf("\nf3: %f",f(3));
```

---

check Appendix [AP 61](#) for dependency:

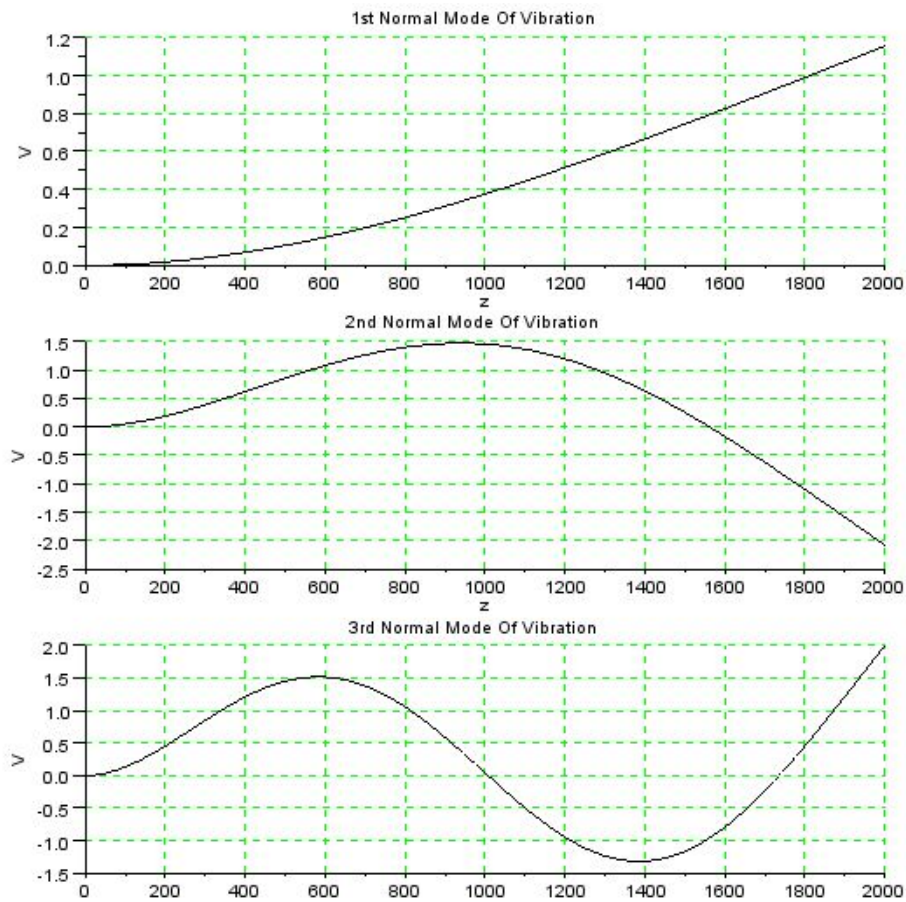


Figure 10.1: Example 5

10\_5data.sci

**Scilab code Exa 10.5 Example 5**

```

1 pathname=get_absolute_file_path('10_5.sce')
2 filename=pathname+filesep()+ '10_5data.sci'
3 exec(filename)

```



```

4 for i=1:3
5     lambda(i)=(i-0.5)*%pi/L;
6     omega(i)=(lambda(i)^2)*(EI/(rho*A))^0.5;
7     fre(i)=omega(i)/(2*%pi);
8     K(i)=(cos(L*lambda(i))+cosh(L*lambda(i)))/(sin(L
        *lambda(i))+sinh(L*lambda(i)));
9 end
10 function [V1]=f(z)
11     V1=K(1)*(cosh(z*lambda(1)) -cos(z*lambda(1)) -K
        (1)*(sinh(z*lambda(1)) -sin(z*lambda(1))));
12 endfunction
13 function [V2]=f1(z)
14     V2=K(2)*(cosh(z*lambda(2)) -cos(z*lambda(2)) -K
        (2)*(sinh(z*lambda(2)) -sin(z*lambda(2))));
15 endfunction
16 function [V3]=f2(z)
17     V3=K(3)*(cosh(z*lambda(3)) -cos(z*lambda(3)) -K
        (3)*(sinh(z*lambda(3)) -sin(z*lambda(3))));
18 endfunction
19 z=linspace(0,L,10*L);
20 subplot(3,1,1),xgrid(3),xtitle('1st Normal Mode Of
    Vibration ','z','V')
21 V1=feval(z,f);
22 plot2d(z,V1);
23 subplot(3,1,2),xgrid(3),xtitle('2nd Normal Mode Of
    Vibration ','z','V')
24 V2=feval(z,f1);
25 plot2d(z,V2);
26 subplot(3,1,3),xgrid(3),xtitle('3rd Normal Mode Of
    Vibration ','z','V')
27 V3=feval(z,f2);
28 plot2d(z,V3);
29 printf("\nf1: %f ",fre(1));
30 printf("\nf2: %f ",fre(2));
31 printf("\nf3: %f ",fre(3));

```

---

check Appendix [AP 60](#) for dependency:

10\_6data.sci

**Scilab code Exa 10.6** Example 6

```
1 pathname=get_absolute_file_path('10_6.sce')
2 filename=pathname+filesep()+ '10_6data.sci'
3 exec(filename)
4 omega=1.1584*(EI/(m*l^3));
5 printf(" \n 1 : %f",omega)
```

---

# Chapter 12

## Structural components of aircraft

check Appendix [AP 59](#) for dependency:

```
12_1data.sci
```

**Scilab code Exa 12.1** Example 1

```
1 pathname=get_absolute_file_path('12_1.sce')
2 filename=pathname+filesep()+ '12_1data.sci'
3 exec(filename)
4 clear
5 Ar=(%pi*d^2)/4;
6 b=((2*Ar*Lv)/(t*Lt))+d;
7 printf(" \nb: %f",b);
```

---

check Appendix [AP 58](#) for dependency:

```
12_2data.sci
```

**Scilab code Exa 12.2** Example 2

```

1 pathname=get_absolute_file_path('12_2.sce')
2 filename=pathname+filesep()+ '12_2data.sci'
3 exec(filename)
4 clear
5 Pe=Load*CL;
6 V=Load/6;
7 r=(DC^2 +AD^2)^0.5;
8 sumr=4*r^2 +2*DC^2; //sum(r^2)
9 S=(Pe/sumr)*r //shear on rivets A and B
10 printf("\nshear force on A & B (S): %f N",S);
11 thetaA=3*pi/4;
12 thetaB= pi/4;
13 RA=(S^2 + V^2 +2*S*V*cos(thetaA))^0.5; //resultent
    force on A
14 RB=(S^2 + V^2 +2*S*V*cos(thetaB))^0.5; //resultent
    force on B
15 printf("\nresultent force on A: %f N",RA);
16 printf("\nresultent force on B: %f N",RB);

```

---

# Chapter 14

## Airframe Loads

check Appendix [AP 57](#) for dependency:

14\_1data.sci

Scilab code Exa 14.1 Example 1

```
1 pathname=get_absolute_file_path('14_1.sce')
2 filename=pathname+filesep()+ '14_1data.sci'
3 exec(filename)
4 T=((W/g)*a)/cos(10*%pi/180);
5 printf("\nT: %f N",T);
6 R=W+T*sin(10*%pi/180);
7 Ls=(R/2)/cos(20*%pi/180); //Load in each strut
8 printf("\nLoad in each strut: %f N",Ls);
9 Li=(Wa/g)*a; //inertial load at CG of fuselage aft of
  AA
10 N=T-Li*cos(10*%pi/180)+Wa*sin(10*%pi/180);
11 S=Li*sin(10*%pi/180)+Wa*cos(10*%pi/180);
12 s=v0^2/(2*a);
13 printf("\nN: %f N",N);
14 printf("\nS: %f N",S);
15 printf("\ns: %f m",s);
```

---

check Appendix [AP 56](#) for dependency:

14\_2data.sci

### Scilab code Exa 14.2 Example 2

```
1 pathname=get_absolute_file_path('14_2.sce')
2 filename=pathname+filesep()+ '14_2data.sci'
3 exec(filename)
4 clear
5 ax=Rh/(W/g); //horizontal deceleration
6 ay=(Rv-W)/(W/g); //vertical deceleration
7 Ialpha=Rv*Sh +Rh*Sv;
8 alpha=(Ialpha*10^6)/Icg;
9 t=v0/ay;
10 omega=alpha*t;
11 printf("\nhorizontal reaction force: %f kN",W*ax/g);
12 printf("\nvertical reaction force: %f kN",W*ay/g);
13 printf("\n : %f rad/s^2",alpha);
14 printf("\nt: %f s",t);
15 printf("\n : %f rad/s",omega);
```

---

check Appendix [AP 55](#) for dependency:

14\_3data.sci

### Scilab code Exa 14.3 Example 3

```
1 pathname=get_absolute_file_path('14_3.sce')
2 filename=pathname+filesep()+ '14_3data.sci'
3 exec(filename)
4 clear
5 L=n*W;
6 Cl1=(L/(0.5*S*rho*v^2));
```

```
7 l1=4.18*cos((alpha1-2)*%pi/180) +0.31*sin((alpha1-2)
   *%pi/180);
8 C12=(L/(0.5*S*rho*v^2))-((c/l1)*Cmcg1);
9 l2=4.18*cos((alpha2-2)*%pi/180) +0.31*sin((alpha2-2)
   *%pi/180);
10 C13=(L/(0.5*S*rho*v^2))-((c/l2)*Cmcg2);
11 //CD from Fig. 14.8(a)
12 CD=0.0875;
13 Lift=0.5*rho*v*v*S*(C11+C12+C13)/3;
14 Drag=0.5*rho*v*v*S*CD;
15 printf("\nLift: %f N",Lift);
16 printf("\nDrag: %f N",Drag);
```

---

# Chapter 15

## Fatigue

check Appendix [AP 54](#) for dependency:

15\_1data.sci

Scilab code Exa 15.1 Example 1

```
1 pathname=get_absolute_file_path('15_1.sce')
2 filename=pathname+filesep()+ '15_1data.sci'
3 exec(filename)
4 clear
5 af=(K^2)/(S^2 *alpha^2 *%pi);
6 Nf=(2/(C*(n-2)*((S*%pi^0.5)^n)))*((1/ai^((n-2)/2))
   -(1/af^((n-2)/2)));
7 printf("\naf: %f mm",af)
8 if(round(Nf)>Nf) then
9     printf("\nNf: %f cycles",round(Nf));
10 else
11     printf("\nNf: %f cycles",round(Nf)+1)
12 end
```

---



# Chapter 16

## Bending of open and closed thin walled beams

check Appendix [AP 53](#) for dependency:

16\_1data.sci

Scilab code Exa 16.1 Example 1

```
1 pathname=get_absolute_file_path('16_1.sce')
2 filename=pathname+filesep()+ '16_1data.sci'
3 exec(filename)
4 Ixx=(a*b^3)/12 - ((a-tx)*(b-2*ty)^3)/12;
5 deff(" [Sz]=f(y)", "Sz=M*y/Ixx");
6 y=[-b/2:0.05:b/2];
7 fplot2d(y,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('Direct stress', '-y-', '- z -');
11 printf("\n z at the top of the beam: %f N/mm^2", f(b
    /2));
12 printf("\n z at the bottom of the beam: %f N/mm^2",
    f(-b/2));
```

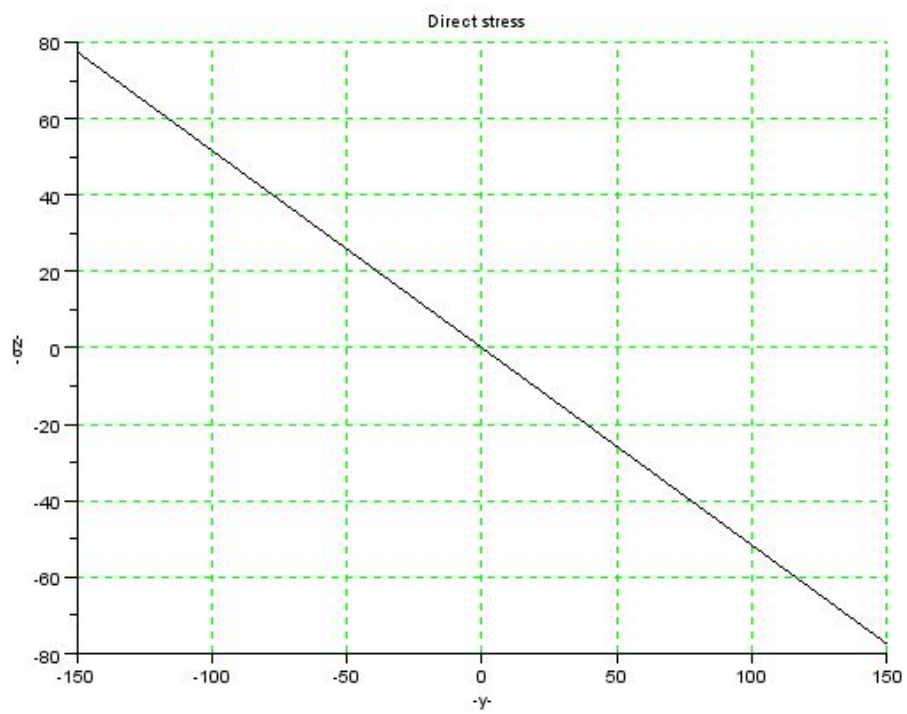


Figure 16.1: Example 1

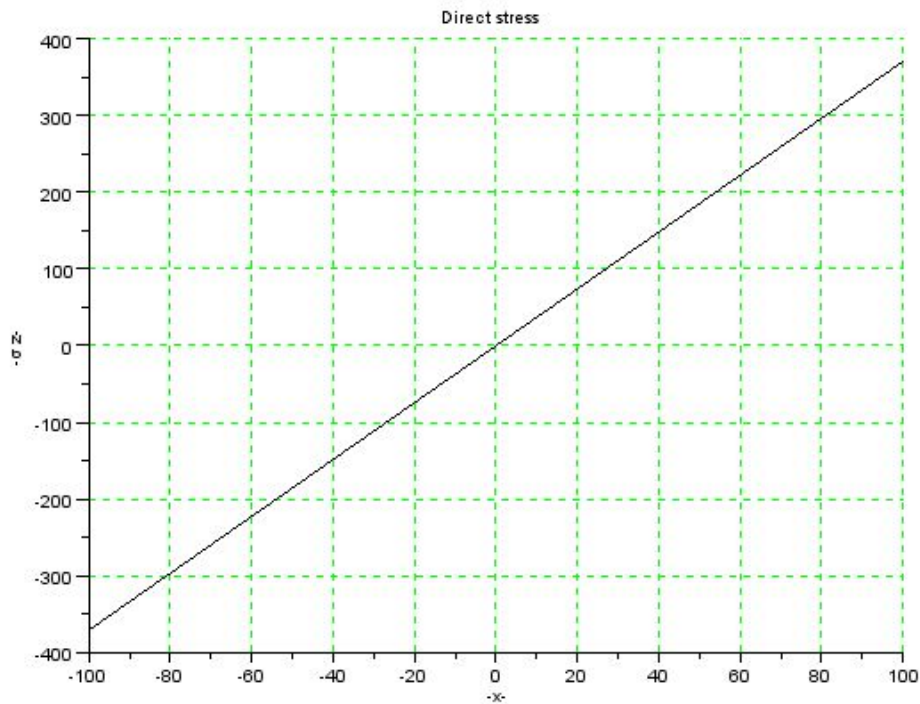


Figure 16.2: Example 2

---

check Appendix [AP 45](#) for dependency:

16\_2data.sci

**Scilab code Exa 16.2** Example 2

```
1 pathname=get_absolute_file_path('16_2.sce')
2 filename=pathname+filesep()+ '16_2data.sci'
3 exec(filename)
4 clear
```

```

5 Iyy=2*(ty*a^3)/12 +((b- 2*ty)*tx^3)/12;
6 deff(" [Sz]=f(x)", "Sz=M*x/Iyy");
7 x=[-a/2:0.05:a/2];
8 fplot2d(x,f);
9 xgrid(3);
10 datatipToggle();
11 xtitle('Direct stress', '-x-', '- z-');
12 printf("\n z at the left hand edges of flanges: %f
      N/mm^2",f(-a/2));
13 printf("\n z at the right hand edges of flanges: %f
      N/mm^2",f(a/2));

```

---

check Appendix [AP 44](#) for dependency:

16\_3data.sci

### Scilab code Exa 16.3 Example 3

```

1 pathname=get_absolute_file_path('16_3.sce')
2 filename=pathname+filesep()+ '16_3data.sci'
3 exec(filename)
4 clear
5 Iyy=2*(ty*a^3)/12 +((b- 2*ty)*tx^3)/12;
6 Ixx=(a*b^3)/12 - ((a-tx)*(b-2*ty)^3)/12;
7 Mx=M*cos(theta),My=M*sin(theta);
8 alpha=(atan((My/Iyy)/(Mx/Ixx)))*180/%pi;
9 deff(" [Sz1]=f(x)", "Sz1=((Mx/Ixx)*(b/2)) -((My/Iyy)*x)
      ");
10 deff(" [Sz2]=f1(x)", "Sz2=((Mx/Ixx)*(-b/2)) -((My/Iyy)*
      x)");
11 deff(" [Sz3]=f2(y)", "Sz3=((Mx/Ixx)*y)");
12 deff(" [Sz4]=f3(x)", "Sz4=0*x");
13 deff(" [Sz5]=f4(y)", "Sz5=0*y");
14 funcprot();

```

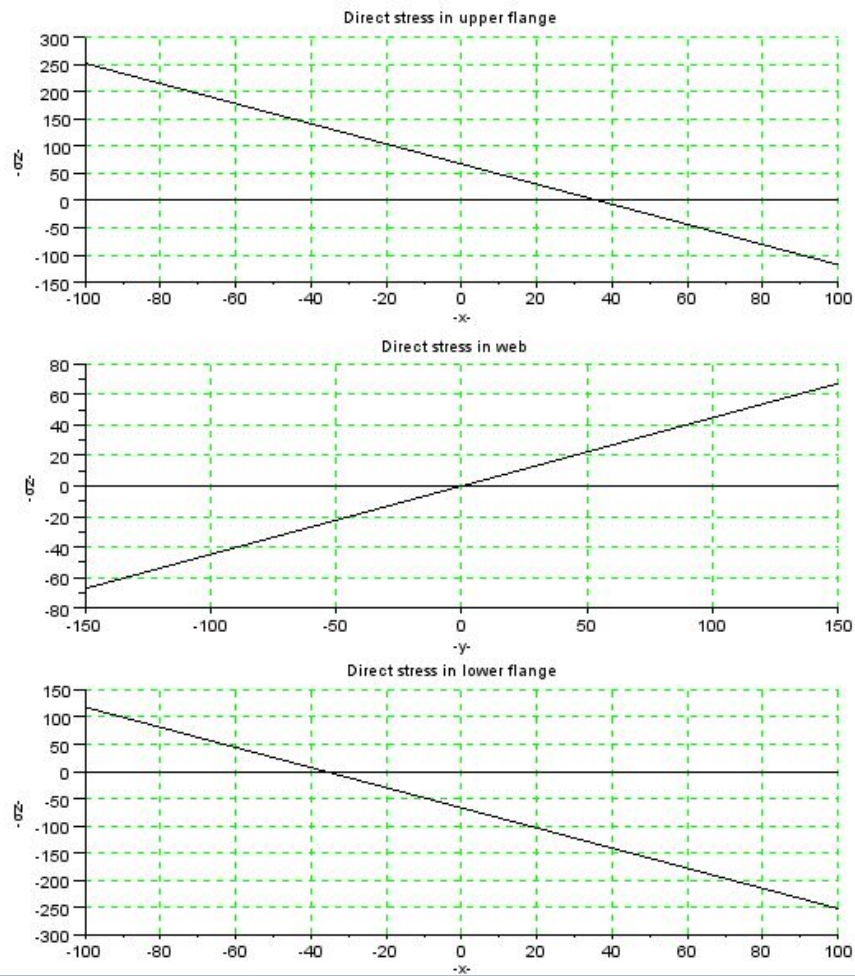


Figure 16.3: Example 3

```

15 y=[-b/2:0.05:b/2];
16 x=[-a/2:0.05:a/2];
17 funcprot(0);
18 subplot(3,1,1);
19 fplot2d(x,f);
20 fplot2d(x,f3);
21 xgrid(3);
22 xtitle('Direct stress in upper flange', '-x-', '-
      z -');
23 subplot(3,1,3);
24 fplot2d(x,f1);
25 fplot2d(x,f3);
26 xgrid(3);
27 xtitle('Direct stress in lower flange', '-x-', '-
      z -');
28 subplot(3,1,2);
29 fplot2d(y,f2);
30 fplot2d(y,f4);
31 xgrid(3);
32 xtitle('Direct stress in web', '-y-', '- z -');
33 datatipToggle();
34 printf("\n click on the point on the plot to view its
      coordinates");

```

---

check Appendix [AP 43](#) for dependency:

16\_4data.sci

#### Scilab code Exa 16.4 Example 4

```

1 pathname=get_absolute_file_path('16_4.sce')
2 ilename=pathname+filesep()+ '16_4data.sci'
3 exec(filename)
4 Yc=(b^2 -t^2 +a*t)/(2*(a+b-t));
5 Xc((((a/2)-a1+ 0.5*t)*a) +((b-t)*t/2))/(a+b-t);

```

```

6 Ixx=(1/3)*((t*((Yc-t)^3 -(Yc-b)^3))+(a*((Yc)^3 -(Yc-
  t)^3)));
7 P=a1- 0.5*t +Xc;
8 Iyy=(1/3)*((t*(P^3 -(P-a)^3))+((b-t)*(Xc^3- (Xc-t)
  ^3)));
9 Ixy=a*t^2 *(Yc- t*0.5) + (b-t)*t*(Yc+ 0.5*t)*12;
10 M1=(1+round(100*Mx*Iyy/(Ixx*Iyy -Ixy^2)))/100,M2=(1+
  round(100*Mx*Ixy/(Ixx*Iyy -Ixy^2)))/100;
11 function [z]=Sz(x,y)
12     z=M1*y -M2*x;
13 endfunction
14 Load=[Sz(-P,Yc);Sz(a-P,Yc);Sz(-P,Yc-t);Sz(a-P,Yc-t);
  Sz(-Xc,Yc-b);Sz(-Xc+t,Yc-b)];
15 Point1=[-P;a-P;-P;a-P;-Xc;-Xc+t];
16 Point2=[Yc;Yc;Yc-t;Yc-t;Yc-b;Yc-b];
17 maximum=Load(1);
18 for i=2:6
19     if(abs(Load(i))>abs(Load(i-1))) then
20         maximum=abs(Load(i));
21         mm=i;
22     end
23 end
24 printf("\n z ,max: %f N/mm^2",Load(mm));
25 disp(" at point");
26 printf("\nX: %f ",Point1(mm));
27 printf("\nY: %f ",Point2(mm));

```

---

check Appendix [AP 42](#) for dependency:

16\_5data.sci

### Scilab code Exa 16.5 Example 5

```

1 pathname=get_absolute_file_path('16_5.sce')

```

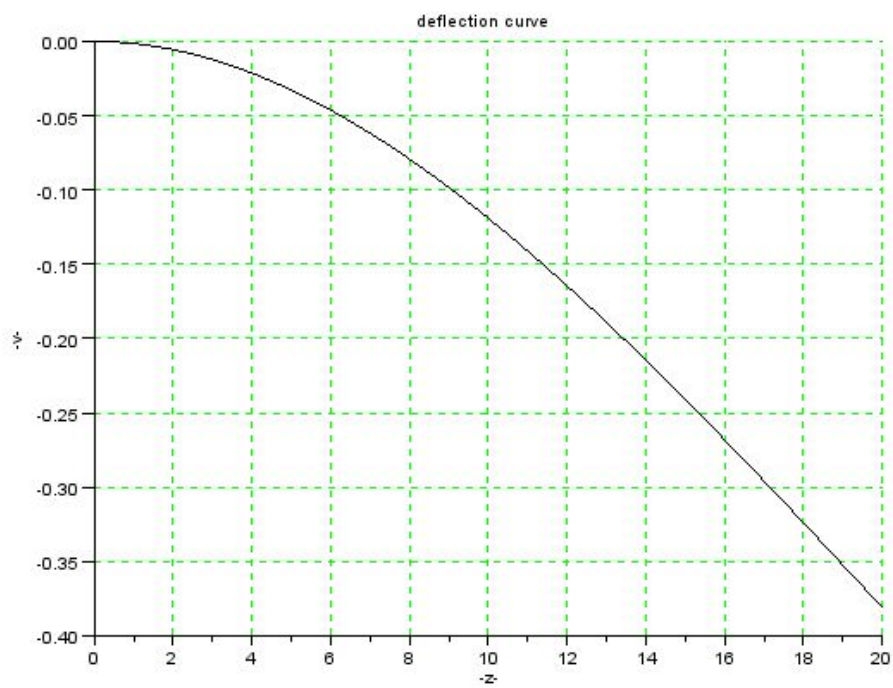


Figure 16.4: Example 5



```

2 filename=pathname+filesep()+ '16_5data.sci '
3 exec(filename)
4 deff(" [v]=f(z)", "v=(-W/(6*EI))*(3*L*z^2 -z^3)");
5 funcprot();
6 z=[0:0.05:L];
7 fplot2d(z,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('deflection curve', '-z-', '-v-');
11 printf("\ntip deflection: %f m",f(L));
12 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 41](#) for dependency:

16\_6data.sci

### Scilab code Exa 16.6 Example 6

```

1 pathname=get_absolute_file_path('16_6.sce')
2 filename=pathname+filesep()+ '16_6data.sci '
3 exec(filename)
4 deff(" [v]=f(z)", "v=(-W/(24*EI))*(6*(L^2)*z^2 -4*L*z
    ^3 +z^4)");
5 funcprot();
6 z=[0:0.05:L];
7 fplot2d(z,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('deflection curve', '-z-', '-v-');
11 printf("\ntip deflection: %f m",f(L));
12 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

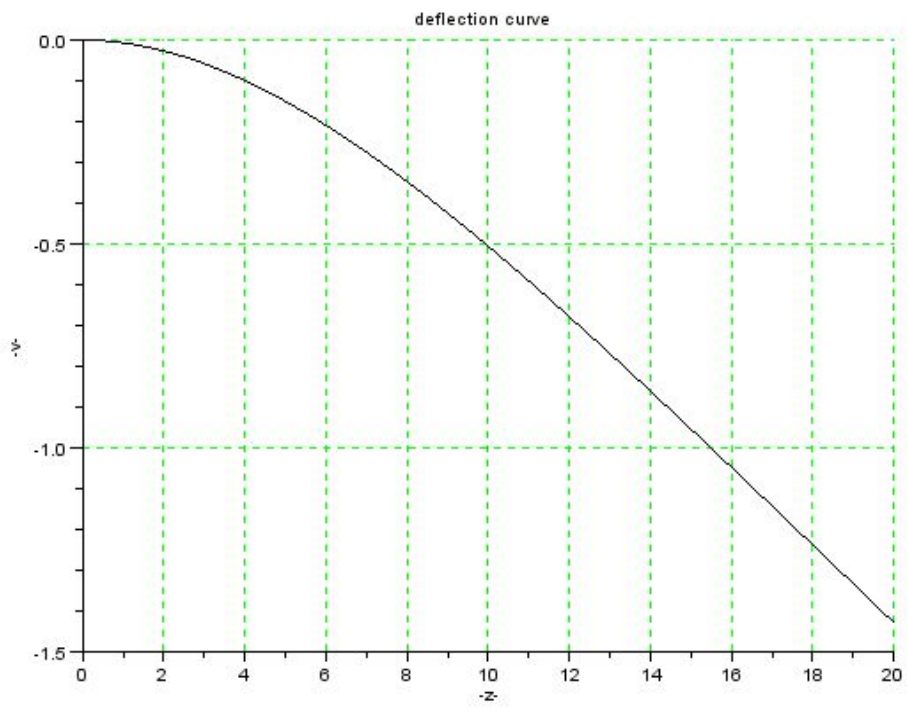


Figure 16.5: Example 6

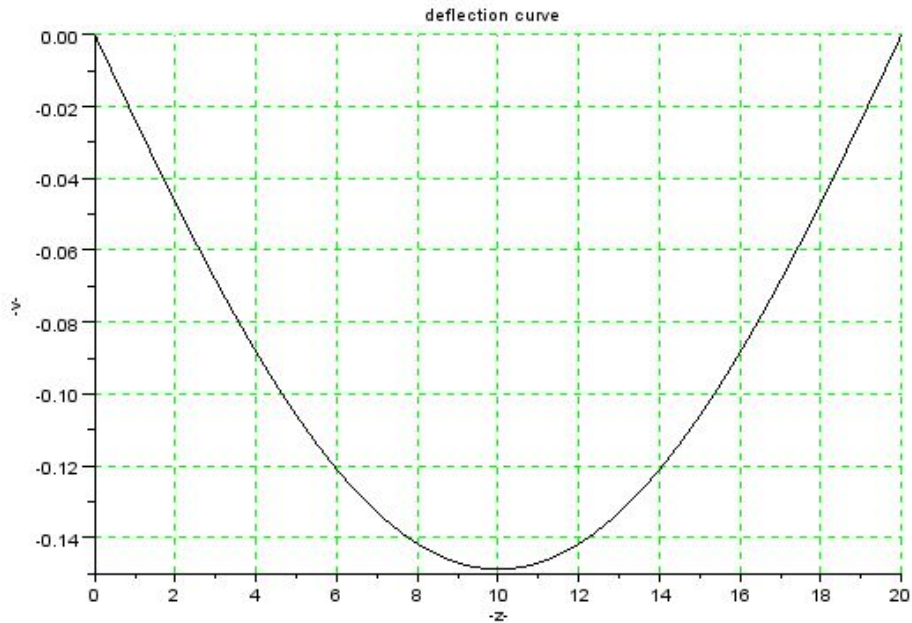


Figure 16.6: Example 7

check Appendix [AP 40](#) for dependency:

16\_7data.sci

**Scilab code Exa 16.7** Example 7

```

1 pathname=get_absolute_file_path('16_7.sce')
2 filename=pathname+filesep()+'16_7data.sci'
3 exec(filename)
4 deff("[v]=f(z)", "v=(W/(24*EI))*(2*L*z^3 -z*L^3 -z^4)");
5 funcprot();
6 z=[0:0.05:L];

```

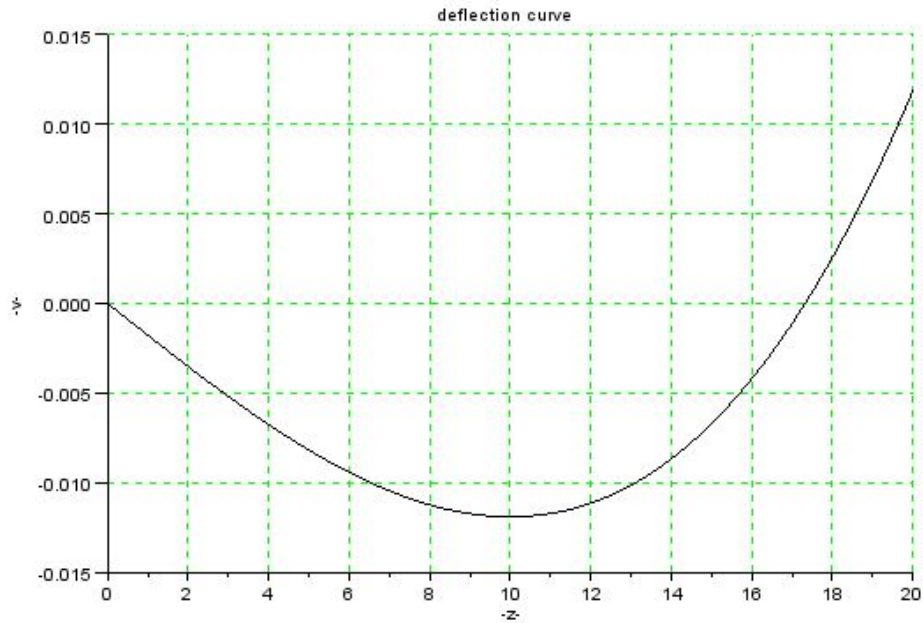


Figure 16.7: Example 8

```

7 fplot2d(z,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('deflection curve', '-z-', '-v-');
11 printf("\nmaximum deflection: %f m",f(L/2));
12 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 39](#) for dependency:

16\_8data.sci

Scilab code Exa 16.8 Example 8

```

1 pathname=get_absolute_file_path('16_8.sce')
2 filename=pathname+filesep()+ '16_8data.sci'
3 exec(filename)
4 deff(" [v]=f(z)", "v=(W/(48*EI))*(4*z^3 -3*z*L^2)");
5 funcprot();
6 z=[0:0.05:L];
7 fplot2d(z,f);
8 xgrid(3);
9 datatipToggle();
10 xtitle('deflection curve', '-z-', '-v-');
11 printf("\nmaximum deflection: %f m",f(L/2));
12 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 38](#) for dependency:

16\_9data.sci

### Scilab code Exa 16.9 Example 9

```

1 pathname=get_absolute_file_path('16_9.sce')
2 filename=pathname+filesep()+ '16_9data.sci'
3 exec(filename)
4 clear
5 function [si]=sing(a,b)
6     if(a<b) then
7         si=0;
8     else
9         si=(a-b);
10    end
11 endfunction
12 deff(" [v]=f(z)", "v=(1/EI)*(((W*z^3)/8) -((W/6)*(sing
    (z,a))^3) -((W/6)*(sing(z,2*a))^3) +((W/3)*(sing(z
    ,3*a))^3) -((5*W*z*a^2)/8))");

```

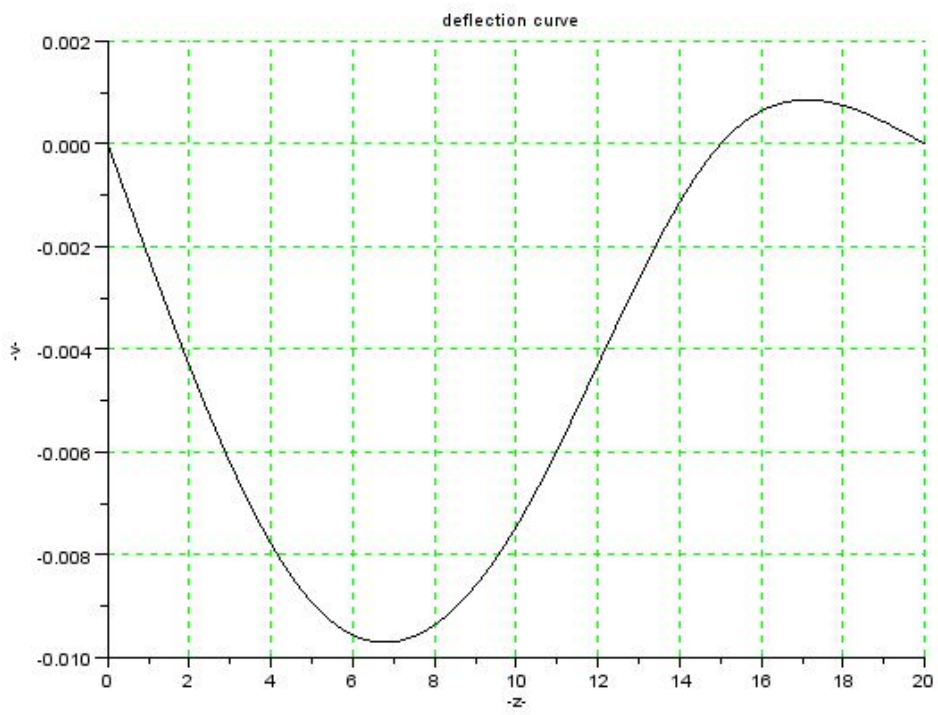


Figure 16.8: Example 9

```

13 for i=1:400*a
14     x0=f((i-1)/100),x1=f(i/100),x2=f((i+1)/100);
15     y1=(x0-x1),y2=(x1-x2);
16     if(y1*y2<0) then
17         if(y1<0) then
18             P=i/100;
19             P1=f(i/100);
20         else
21             Q=i/100;
22             Q1=f(i/100);
23         end
24     end
25 end
26 z=[0:0.05:4*a];
27 fplot2d(z,f);
28 xgrid(3);
29 xtitle('deflection curve', '-z-', '-v-');
30 datatipToggle();
31 printf("\nmaximum positive deflection: %f m",P1);
32 printf("\nat z= %f m",P);
33 printf("\nmaximum negative deflection: %f m",Q1);
34 printf("\nat z= %f m",Q);
35 printf("\n\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 52](#) for dependency:

16\_10data.sci

### Scilab code Exa 16.10 Example 10

```

1 pathname=get_absolute_file_path('16_10.sce')
2 filename=pathname+filesep()+ '16_10data.sci'
3 exec(filename)

```

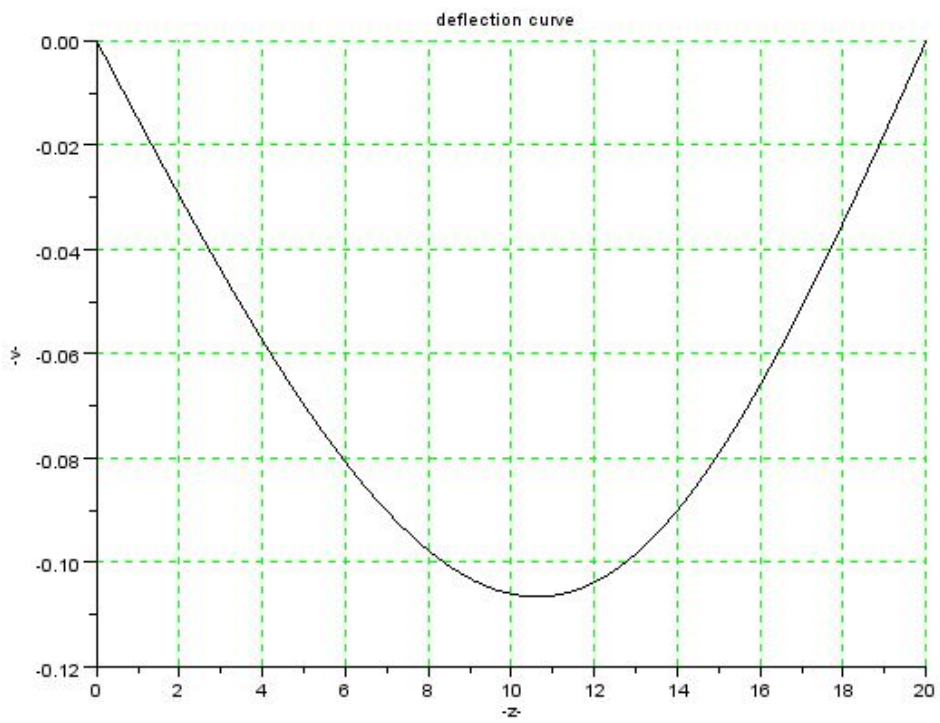


Figure 16.9: Example 10



```

4 clear
5 function [si]=sing(a,b)
6     if(a<b) then
7         si=0;
8     else
9         si=(a-b);
10    end
11 endfunction
12 deff(" [v]=f(z)", "v=(1/EI)*(((L*W*z^3)/64) -((W/24)*(
    sing(z,0.5*L))^4)+((W/24)*(sing(z,0.75*L))^4)
    -((27*W*z*L^3)/2048))");
13 funcprot();
14 for i=1:100*L
15     x0=f((i-1)/100),x1=f(i/100),x2=f((i+1)/100);
16     y1=(x0-x1),y2=(x1-x2);
17     if(y1*y2<0) then
18         P=i/100;
19         P1=f(i/100);
20         printf("\nmaximum deflection: %f m",P1);
21         printf("\nat z= %f m",P);
22     end
23 end
24
25 z=[0:0.05:L];
26 fplot2d(z,f);
27 xgrid(3);
28 datatipToggle();
29 xtitle('deflection curve', '-z-', '-v-');
30 printf("\n\nclick on the point to view its
    coordinate on the plot");

```

---

check Appendix [AP 51](#) for dependency:

16\_11data.sci

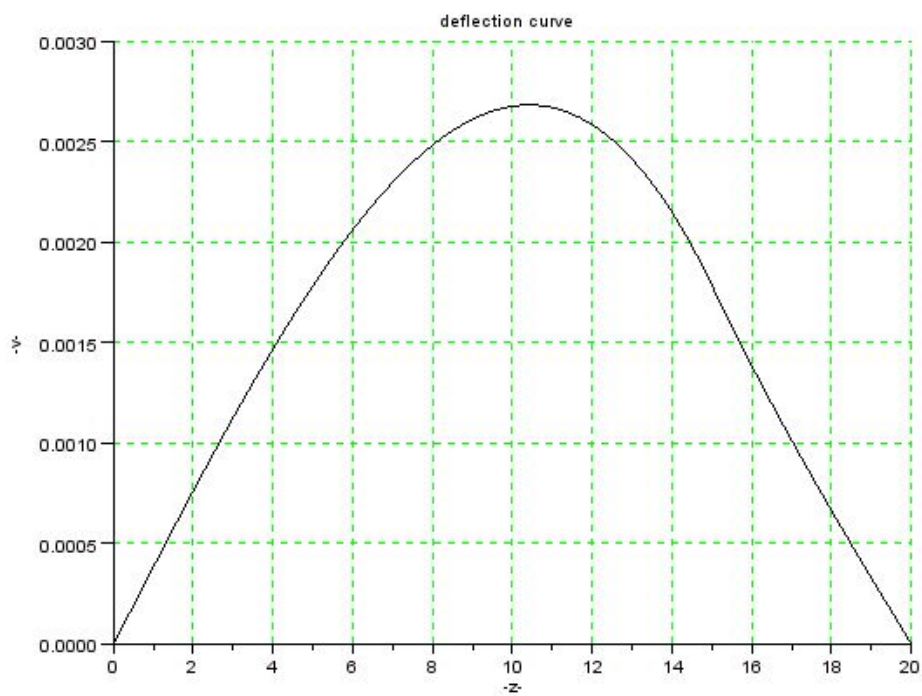


Figure 16.10: Example 11

### Scilab code Exa 16.11 Example 11

```
1 pathname=get_absolute_file_path('16_11.sce')
2 filename=pathname+filesep()+ '16_11data.sci'
3 exec(filename)
4 function [si]=sing(a,a1)
5     if(a<a1) then
6         si=0;
7     else
8         si=(a-a1);
9     end
10 endfunction
11 deff("[v]=f(z)", "v=(M0/(EI*6*L))*(-z^3 +(3*L*(sing(z
    ,b))^2)-(2*L^2 -6*L*b +3*b^2)*z)");
12 z=[0:0.05:L];
13 fplot2d(z,f);
14 xgrid(3);
15 datatipToggle();
16 xtitle('deflection curve', '-z-', '-v-');
17 printf("\n\nclick on the point to view its
    coordinate on the plot");
```

---

check Appendix [AP 50](#) for dependency:

16\_12data.sci

### Scilab code Exa 16.12 Example 12

```
1 pathname=get_absolute_file_path('16_12.sce')
2 filename=pathname+filesep()+ '16_12data.sci'
3 exec(filename)
4 P=(W*Ixy/(E*(Ixx*Iyy -Ixy^2)));
5 P1=-(W*Iyy/(E*(Ixx*Iyy -Ixy^2)));
6 deff("[u]=f(z)", "u=P*(0.5*L*z^2 -(1/6)*z^3)");
```

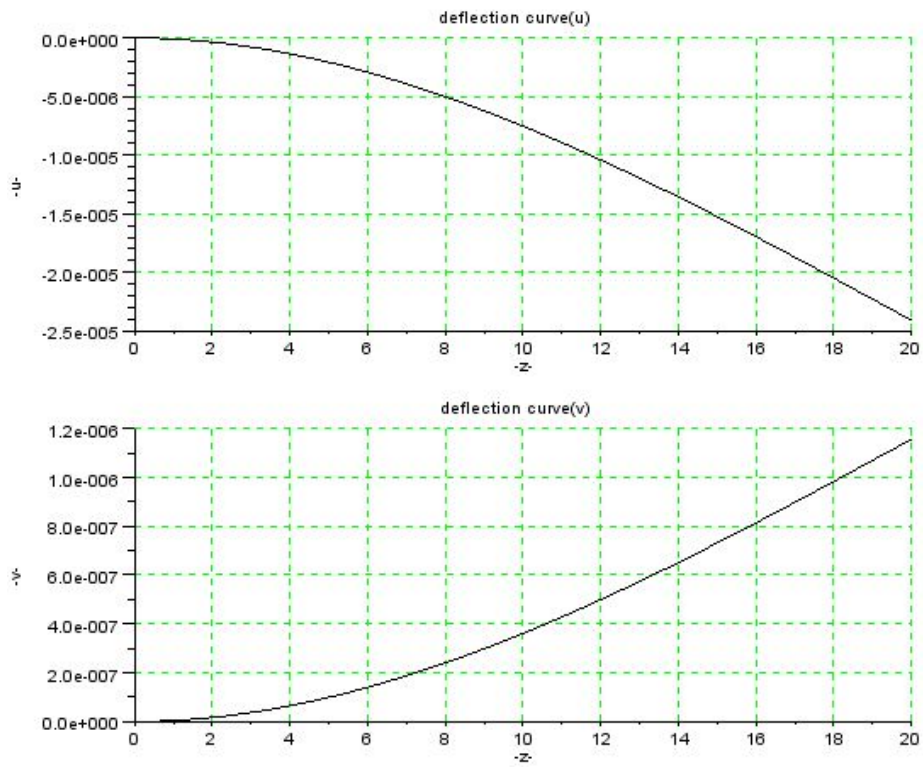


Figure 16.11: Example 12

```

7 deff (" [v]=f1 (z)", "v=P1*(0.5*L*z^2 -(1/6)*z^3)");
8 funcprot ();
9 z=[0:0.05:L];
10 subplot(2,1,1);
11 fplot2d(z,f);
12 xgrid(3);
13 xtitle('deflection curve(u)', '-z-', '-u-');
14 subplot(2,1,2);
15 fplot2d(z,f1);
16 xgrid(3);
17 xtitle('deflection curve(v)', '-z-', '-v-');
18 datatipToggle();
19 printf("\nmaximum value of u: %f",f(L));
20 printf("\nmaximum value of v: %f",f1(L));
21 printf("\n\nclick on the point to view its
coordinate on the plot");

```

---

check Appendix [AP 49](#) for dependency:

16\_13data.sci

### Scilab code Exa 16.13 Example 13

```

1 pathname=get_absolute_file_path('16_13.sce')
2 filename=pathname+filesep()+ '16_13data.sci'
3 exec(filename)
4 dw=d- 2*tf;
5 Ixx=2*(((b*tf^3)/12)+ b*tf*((dw+tf)/2)^2) + (tw*dw
^3)/12;
6 Iyy=(2*tf*b^3)/12 + (dw*dw^3)/12;
7 printf("\n Ixx= %f mm^4",Ixx);
8 printf("\n Iyy= %f mm^4",Iyy)

```

---

check Appendix [AP 48](#) for dependency:

16\_14data.sci

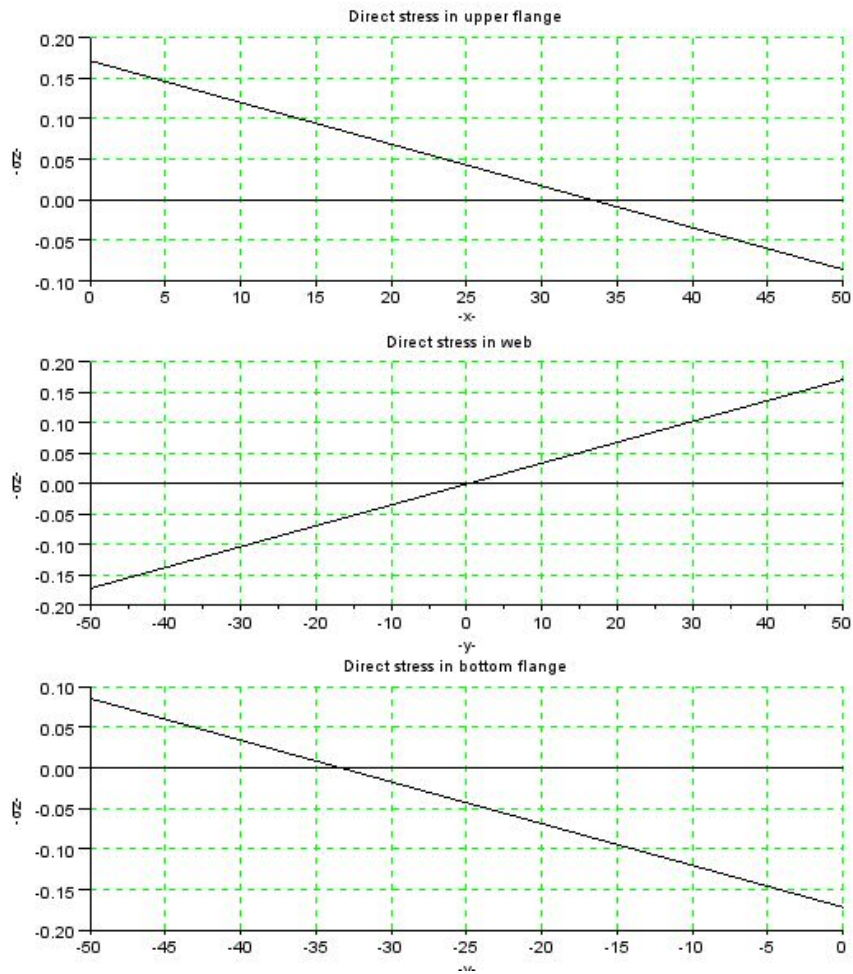


Figure 16.12: Example 14

### Scilab code Exa 16.14 Example 14

```
1 pathname=get_absolute_file_path('16_14.sce')
2 filename=pathname+filesep()+ '16_14data.sci'
3 exec(filename)
4 Ixx=(t*h^3)/3;
5 Iyy=(t*h^3)/12;
6 Ixy=(t*h^3)/8;
7 P=Mx/(Ixx*Iyy -Ixy*Ixy);
8 deff(" [Sz1]=f(x)", "Sz1=P*(Iyy*h*0.5 -Ixy*x)"); //
   distribution of direct stress in top flange
9 deff(" [Sz2]=f1(y)", "Sz2=P*(Iyy*y)"); //distribution
   of direct stress in web
10 deff(" [Sz3]=f2(x1)", "Sz3=P*(-Iyy*h*0.5 -Ixy*x1)"); //
   distribution of direct stress in top flange
11 deff(" [Sz4]=f3(x)", "Sz4=0*x");
12 deff(" [Sz5]=f4(y)", "Sz5=0*y");
13 y=[-h/2:0.05:h/2];
14 x=[0:0.05:h/2];
15 x1=[-h/2:0.05:0];
16 funcprot(0);
17 subplot(3,1,1);
18 fplot2d(x,f);
19 fplot2d(x,f3);
20 xgrid(3);
21 xtitle('Direct stress in upper flange', '-x-', '-
   z -');
22 subplot(3,1,2);
23 fplot2d(y,f1);
24 fplot2d(y,f4);
25 xgrid(3);
26 xtitle('Direct stress in web', '-y-', '- z -');
```

```

27 subplot(3,1,3);
28 fplot2d(x1,f2);
29 fplot2d(x1,f3);
30 xgrid(3);
31 xtitle('Direct stress in bottom flange', '-y-', '-z-');
32 datatipToggle();

```

---

check Appendix [AP 47](#) for dependency:

16\_15data.sci

#### Scilab code Exa 16.15 Example 15

```

1 pathname=get_absolute_file_path('16_15.sce')
2 filename=pathname+filesep()+ '16_15data.sci'
3 exec(filename)
4 Nt=4*E*alpha*a*t*T0;
5 Mxt=2*E*alpha*t*T0*a^2;
6 Myt=-E*alpha*t*T0*a^2;
7 printf("\nNt: %f ",Nt);
8 printf("\nMxt: %f ",Mxt);
9 printf("\nMyt: %f ",Myt);

```

---

check Appendix [AP 46](#) for dependency:

16\_16data.sci

#### Scilab code Exa 16.16 Example 16

```

1 pathname=get_absolute_file_path('16_16.sce')
2 filename=pathname+filesep()+ '16_16data.sci'
3 exec(filename)
4 Nt=4*E*alpha*a*t*T0;

```



```
5 Mxt=(8/3)*E*alpha*t*T0*a^2;
6 Myt=-E*alpha*t*T0*a^2;
7 printf("\nNt: %f ",Nt);
8 printf("\nMxt: %f ",Mxt);
9 printf("\nMyt: %f ",Myt);
```

---

# Chapter 17

## Shear of beams

check Appendix [AP 37](#) for dependency:

17\_1data.sci

Scilab code Exa 17.1 Example 1

```
1 pathname=get_absolute_file_path('17_1.sce')
2 filename=pathname+filesep()+ '17_1data.sci'
3 exec(filename)
4 Ixx=(t*h^3)/3, Iyy=(t*h^3)/12, Ixy=(t*h^3)/8;
5 A=0.5*(Sy/(Ixx*Iyy -Ixy^2));
6 function [q1]=q12(s1),
7     q1=A*(((h*t*(Iyy-Ixy))*s1)+(Ixy*t*s1^2));
8 endfunction
9 s1=linspace(0, h/2, 5*h);
10 q1=feval(s1, q12);
11 subplot(3,1,1)
12 plot2d(s1, q1);
13 xgrid(3);
14 xtitle('Direct stress in lower flange', '-s1-', '
    - z -');
```

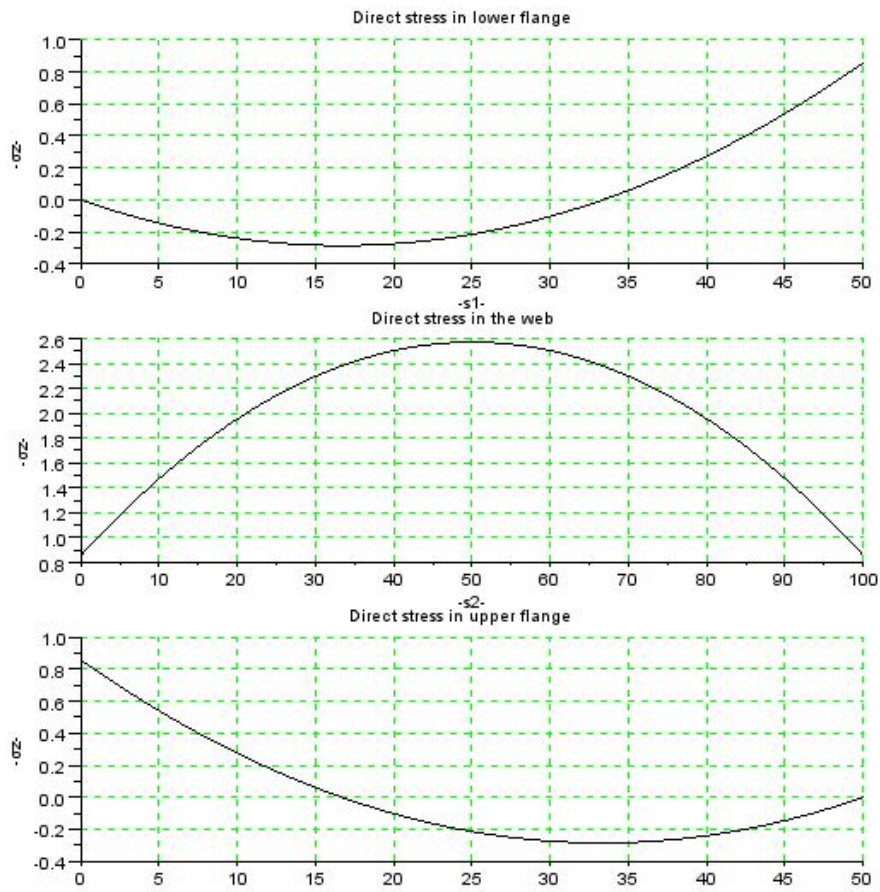


Figure 17.1: Example 1

```

15 function [q2]=q23(s2),
16     q2=(A*((Iyy*t*h*s2)-(Iyy*t*s2^2)))+q12(h/2);
17 endfunction
18 s2=linspace(0,h,10*h);
19 q2=feval(s2,q23);
20 subplot(3,1,2)
21 plot2d(s2,q2);
22 xgrid(3);
23 xtitle('Direct stress in the web', '-s2-', '- z -');
24 function [q3]=q34(s3),
25     q3=(A*((Ixy*t*s3*s3)-(Iyy*t*h*s3)))+q23(h);
26 endfunction
27 s3=linspace(0,h/2,5*h);
28 q3=feval(s3,q34);
29 subplot(3,1,3)
30 plot2d(s3,q3);
31 xgrid(3);
32 xtitle('Direct stress in upper flange', '-s3-', '- z -');
33 datatipToggle();
34 printf("\n click on the point to view its coordinate
    on the plot")

```

---

check Appendix [AP 36](#) for dependency:

17\_2data.sci

### Scilab code Exa 17.2 Example 2

```

1 pathname=get_absolute_file_path('17_2.sce')
2 filename=pathname+filesep()+ '17_2data.sci'
3 exec(filename)
4 Es=(3*b*b)/(h*(1+ 6*b/h));
5 printf("\n s : %f mm",Es);

```

---

check Appendix [AP 35](#) for dependency:

17\_3data.sci

### Scilab code Exa 17.3 Example 3

```
1 pathname=get_absolute_file_path('17_3.sce')
2 filename=pathname+filesep()+ '17_3data.sci'
3 exec(filename)
4 Es=-3.35*a;
5 printf(" \n s : %f mm",Es);
```

---

# Chapter 18

## Torsion of beams

check Appendix [AP 34](#) for dependency:

18\_1data.sci

Scilab code Exa 18.1 Example 1

```
1 pathname=get_absolute_file_path('18_1.sce')
2 filename=pathname+filesep()+ '18_1data.sci'
3 exec(filename)
4 clear
5 A=%pi*d*d/4;
6 tmin1=Tmax/(2*A*Smax);
7 tmin2= (Tmax*%pi*d*0.5*L)/(4*A*A*G*angle);
8 if(tmin1<tmin2) then
9     printf("\nminimum allowable thickness is: %f mm"
10           ,tmin2);
11 else
12     printf("\nminimum allowable thickness is: %f mm"
13           ,tmin1);
14 end
```

---

check Appendix [AP 33](#) for dependency:

18\_2data.sci

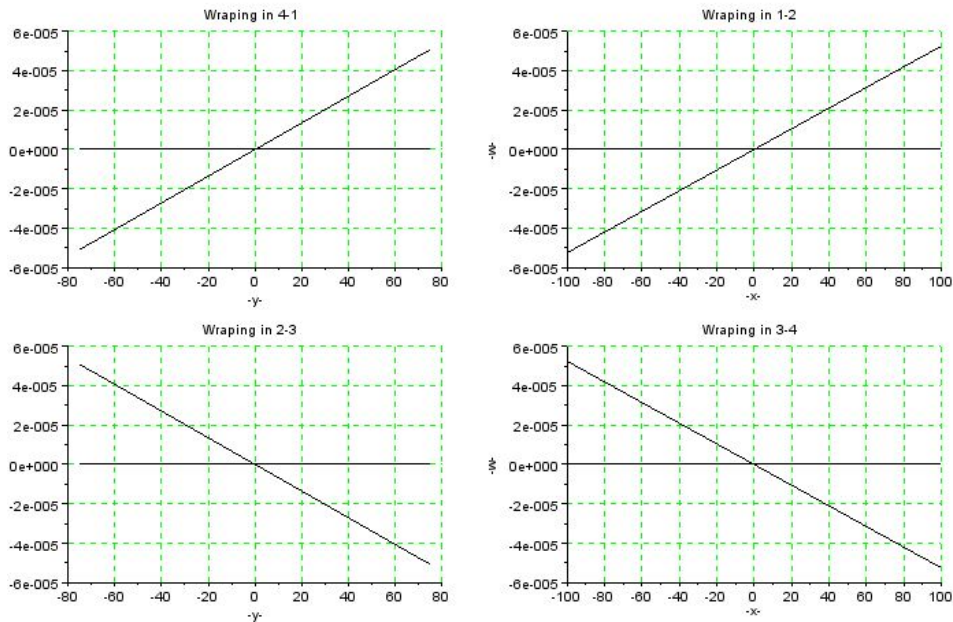


Figure 18.1: Example 2

### Scilab code Exa 18.2 Example 2

```

1 pathname=get_absolute_file_path('18_2.sce')
2 filename=pathname+filesep()+ '18_2data.sci'
3 exec(filename)
4 clear
5 del=2*((b/tb)+(a/ta)); //
6 A=a*b;
7 defff(" [W41]=f(s1)", "W41=(T/(2*A*G))*((s1/tb)+(del*a*
      s1/(4*A)))");
8 defff(" [W12]=f1(s2)", "W12=(T/(2*A*G))*((s2/ta)+(del*b
      *s2/(4*A)))");

```

```

9  deff (" [W23]=f2 (s1)" , "W23=-((T/(2*A*G)) * ((s1/tb)+(del
    *a*s1/(4*A))))");
10 deff (" [W34]=f3 (s2)" , "W34=-((T/(2*A*G)) * ((s2/ta)+(del
    *b*s2/(4*A))))");
11 deff (" [Sz]=f4 (s1)" , "Sz=0*s1");
12 deff (" [Sz1]=f5 (s2)" , "Sz1=0*s2");
13 funcprot (0);
14 s1=[-b/2:0.05:b/2];
15 s2=[-a/2:0.05:a/2];
16 subplot (2,2,1)
17 fplot2d(s1,f)
18 fplot2d(s1,f4)
19 xgrid(3);
20 xtitle('Wrapping in 4-1', '-y-', '-w-');
21 subplot(2,2,2)
22 fplot2d(s2,f1)
23 fplot2d(s2,f5)
24 xgrid(3);
25 xtitle('Wrapping in 1-2', '-x-', '-w-');
26 subplot(2,2,3)
27 fplot2d(s1,f2)
28 fplot2d(s1,f4)
29 xgrid(3);
30 xtitle('Wrapping in 2-3', '-y-', '-w-');
31 subplot(2,2,4)
32 fplot2d(s2,f3)
33 fplot2d(s2,f5)
34 xgrid(3);
35 xtitle('Wrapping in 3-4', '-x-', '-w-');
36 datatipToggle();
37 printf("\n\nclick on the point on the plot to view its
    coordinates")

```

---

check Appendix [AP 32](#) for dependency:

18\_3data.sci



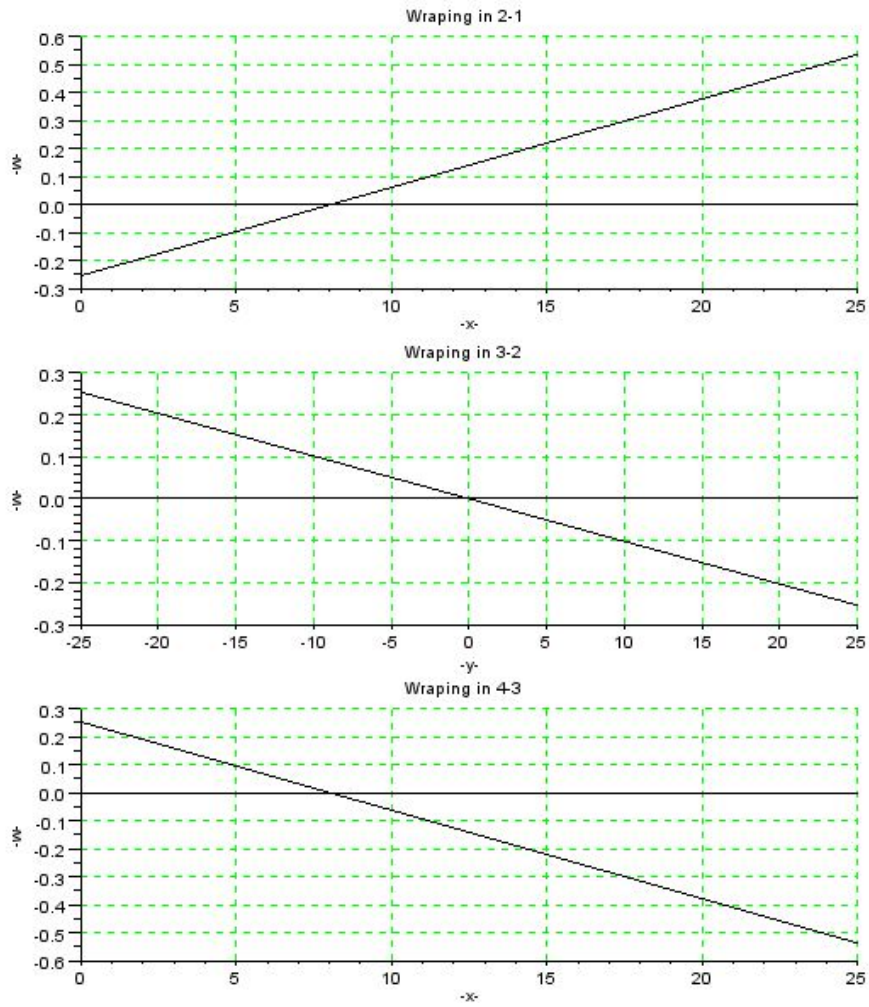


Figure 18.2: Example 3

### Scilab code Exa 18.3 Example 3

```
1 pathname=get_absolute_file_path('18_3.sce')
2 filename=pathname+filesep()+ '18_3data.sci'
3 exec(filename)
4 clear
5 J=(2*a*ty^3 + b*tx^3)/3;
6 if(tx>ty) then
7     tmax=tx*T/J;
8 else
9     tmax=ty*T/J;
10 end
11 printf("\nmaximum shear stress: %f N/mm^2",tmax);
12 Ixx=a*ty*b*b/2 +(tx*b^3)/12;
13 Es=(ty*(a*b)^2)/(4*Ixx);
14 deff(" [W32]=f(s1)", "W32=-2*(T/(J*G))*(0.5*Es*s1)");
15 deff(" [W21]=f1(s2)", "W21=-2*(T/(J*G))*(0.5*Es*a
    -0.5*a*s2)");
16 deff(" [W43]=f2(s2)", "W43=2*(T/(J*G))*(0.5*Es*a -0.5*
    a*s2)");
17 deff(" [Sz]=f3(s1)", "Sz=0*s1");
18 deff(" [Sz1]=f4(s2)", "Sz1=0*s2");
19 s1=[-b/2:0.05:b/2];
20 s2=[0:0.05:a];
21 subplot(3,1,1)
22 fplot2d(s2,f1)
23 fplot2d(s2,f4)
24 xgrid(3);
25 xtitle('Wrapping in 2-1', '-x-', '-w-');
26 subplot(3,1,2)
27 fplot2d(s1,f)
28 fplot2d(s1,f3)
29 xgrid(3);
30 xtitle('Wrapping in 3-2', '-y-', '-w-');
```

```
31 subplot(3,1,3)
32 fplot2d(s2,f2)
33 fplot2d(s2,f4)
34 xgrid(3);
35 xtitle( 'Wrapping in 4-3', ' -x- ', '-w-');
36 datatipToggle();
37 printf("\nclick on the point on the plot to view its
    coordinates")
```

---

# Chapter 19

## Combined open and closed section beams

check Appendix [AP 31](#) for dependency:

19\_1data.sci

Scilab code Exa 19.1 Example 1

```
1 pathname=get_absolute_file_path('19_1.sce')
2 filename=pathname+filesep()+ '19_1data.sci'
3 exec(filename)
4 clear
5 Yc=(2*L45^2 +L12^2)/(4*L12 +4*L45);
6 Ixx=((2*L12 +L45)*t*Yc^2) +(L45*t*(L45-Yc)^2)+ (2*t
    /3)*((2*Yc^3) -((Yc-L45)^3) -((Yc-L12)^3));
7 P=-Sy/Ixx;
8 function[q1]=q12(s1),
9     q1=P*t*(Yc-L12)*s1 +P*t*0.5*s1^2;
10 endfunction
11 s1=linspace(0,L12,10*L12);
12 q1=feval(s1,q12);
```

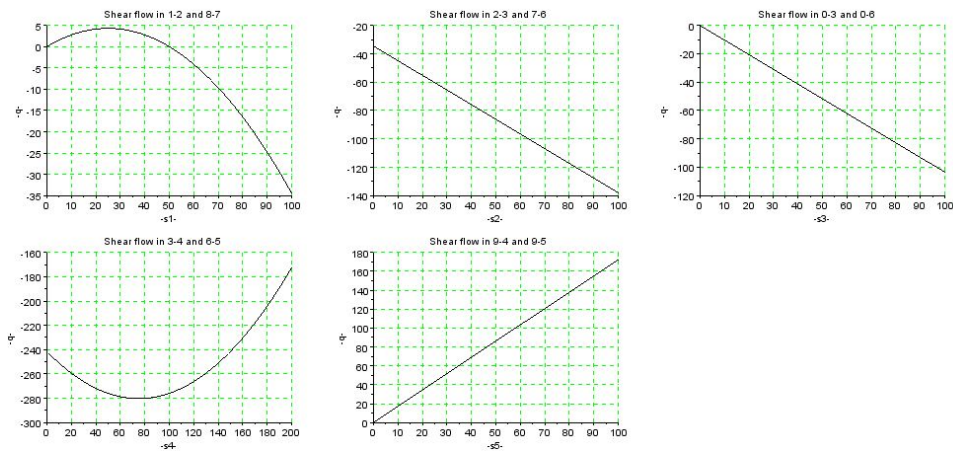


Figure 19.1: Example 1

```

13 subplot(2,3,1)
14 plot2d(s1,q1)
15 xgrid(3);
16 xtitle('Shear flow in 1-2 and 8-7', '-s1-', '-q-');
17 function[q2]=q23(s2),
18     q2= P*t*Yc*s2+q12(L12);
19 endfunction
20 s2=linspace(0,L12,10*L12);
21 q2=feval(s2,q23);
22 subplot(2,3,2)
23 plot2d(s2,q2)
24 xgrid(3);
25 xtitle('Shear flow in 2-3 and 7-6', '-s2-', '-q-');
26 function[q3]=q03(s3),
27     q3=P*t*Yc*s3;
28 endfunction
29 s3=linspace(0,L45/2,5*L45);
30 q3=feval(s3,q03);
31 subplot(2,3,3)
32 plot2d(s3,q3)
33 xgrid(3);

```

```

34 xtitle( 'Shear flow in 0-3 and 0-6', ' -s3- ', '-q-'
    );
35 function [q4]=q34(s4),
36     q4=(P*t*Yc*s4 -0.5*P*t*s4^2)+q03(L45/2)+q23(L12)
    ;
37 endfunction
38 s4=linspace(0,L45,10*L45);
39 q4=feval(s4,q34);
40 subplot(2,3,4)
41 plot2d(s4,q4)
42 xgrid(3);
43 xtitle( 'Shear flow in 3-4 and 6-5', ' -s4- ', '-q-'
    );
44 function [q5]=q94(s5),
45     q5=P*t*(Yc-L45)*s5;
46 endfunction
47 s5=linspace(0,L45/2,5*L45);
48 q5=feval(s5,q94);
49 subplot(2,3,5)
50 plot2d(s5,q5)
51 xgrid(3);
52 xtitle( 'Shear flow in 9-4 and 9-5', ' -s5- ', '-q-'
    );
53 datatipToggle();
54 printf(" \n click on the point on the plot to view its
    coordinates");

```

---

check Appendix [AP 30](#) for dependency:

19\_2data.sci

### Scilab code Exa 19.2 Example 2

```

1 pathname=get_absolute_file_path('19_2.sce')
2 filename=pathname+filesep()+ '19_2data.sci'
3 exec(filename)

```

```
4 GJcl=((4*A*A*G*t12)/(L12+L34));
5 GJo=((L34+L13)*G*t^3)/3
6 GJ=GJcl+GJo;
7 Dtheta=T/GJ;
8 qcl=GJcl*Dtheta/(2*A);
9 tmaxcl=qcl/t12;
10 tmaxo=G*t13*Dtheta;
11 printf("\n max , cl: %f N/mm^2",tmaxcl);
12 printf("\n max , op: %f N/mm^2",tmaxo);
```

---

# Chapter 20

## Structural idealization

check Appendix [AP 29](#) for dependency:

20\_1data.sci

Scilab code Exa 20.1 Example 1

```
1 pathname=get_absolute_file_path('20_1.sce')
2 filename=pathname+filesep()+ '20_1data.sci'
3 exec(filename)
4 L25=(L16*L12+L34*L23)/(L12+L23);
5 B1=A+ (t16*L16/6) +(t12*L12/6)*(2+(L25/L16));
6 B6=B1;
7 B2= 2*A + (t12*L12/6)*(2+(L16/L25))+(t25*L25/6) +(
      t23*L23/6)*(2+(L34/L25));
8 B5=B2;
9 B3=A + (t23*L23/6)*(2+(L25/L34)) + (t34*L34/6);
10 B4=B3;
11 printf("\nB1 = B6 = %f mm^2",B1);
12 printf("\nB2 = B5 = %f mm^2",B2);
13 printf("\nB3 = B4 = %f mm^2",B3)
```

---

check Appendix [AP 28](#) for dependency:

20\_2data.sci



### Scilab code Exa 20.2 Example 2

```
1 pathname=get_absolute_file_path('20_2.sce')
2 filename=pathname+filesep()+ '20_2data.sci'
3 exec(filename)
4 clear
5 Yc=(2*(B'*D) -B(1,:)*D(1,:))/((2*sum(B))-(B(1,:)+B
    (9,:)));
6 Y=D-Yc*ones(9,1);
7 for i=1:9
8     Ixx(i)=B(i)*(Y(i))^2;
9 end
10 P=2*sum(Ixx)-Ixx(1)-Ixx(9);
11 for i=1:9
12     Sz(i)=(Mx/P)*Y(i); // z
13 end
14 printf("\n z : %f N/mm^2",Sz);
```

---

check Appendix [AP 27](#) for dependency:

20\_3data.sci

### Scilab code Exa 20.3 Example 3

```
1 pathname=get_absolute_file_path('20_3.sce')
2 filename=pathname+filesep()+ '20_3data.sci'
3 exec(filename)
4 clear
5 Ixx=4*A*L^2;
6 B=[A;A;A;A];
7 Y=[L;L;-L;-L];
8 q(1)=(-Sy/Ixx)*B(1)*Y(1);
```

```

9 for i=2:4
10     q(i)=((-Sy/Ixx)*B(i)*Y(i)) +q(i-1);
11 end
12 printf("\nq12: %f N/mm",q(1));
13 printf("\nq23: %f N/mm",q(2));
14 printf("\nq34: %f N/mm",q(3));

```

---

check Appendix [AP 26](#) for dependency:

20\_4data.sci

#### Scilab code Exa 20.4 Example 4

```

1 pathname=get_absolute_file_path('20_4.sce')
2 filename=pathname+filesep()+ '20_4data.sci'
3 exec(filename)
4 clear
5 for i=1:8
6     I(i)=B(i)*y(i)*y(i);
7 end
8 Ixx=sum(I);
9 P=(-Sy/Ixx);
10 qb1(1)=0, qb2(1)=0;
11 for i=2:3
12     qb1(i)=P*B(i+1)*y(i+1) +qb1(i-1);
13     qb2(i)=(P*B(i+5)*y(i+5) +qb2(i-1));
14 end
15 qb1(4)=qb1(2);
16 qb2(4)=qb2(2);
17 qb=[qb1; -qb2];
18 A= (y(1)+y(2))*x(3) +(y(2)+y(3))*x(2) +(y(3)+y(4))*x
    (1);
19 qs0=(qb(7)*(x(2)+x(3))*(2*y(1)) +2*qb(6)*(x(3)*y(2)
    +x(3)*(y(2)-y(1))) + 2*qb(1)*x(2)*y(3) -2*qb(2)*x
    (1)*y(3) -qb(3)*2*y(4)*x(1))/(2*A);
20 q=[qb1+qs0*ones(4,1); qb2+qs0*ones(4,1)];

```

```
21 disp("shear flow (in order q23 ,q34 ,q45 ,q56 ,q67 ,q12 ,  
    q78 ,q81)");  
22 printf("\n q: %f N/mm" ,q)
```

---

# Chapter 21

## Wing spars and box beams

check Appendix [AP 25](#) for dependency:

21\_1data.sci

Scilab code Exa 21.1 Example 1

```
1 pathname=get_absolute_file_path('21_1.sce')
2 filename=pathname+filesep()+ '21_1data.sci'
3 exec(filename)
4 Mx=-Sy*L1;//moment at section AA
5 Wa=(We*(L-L1)+ W*L1)/L;//width of section AA
6 Ixx=2*A*(Wa/2)^2 + (1/12)*t*Wa^3;
7 Sz1=Mx*(Wa/2)/Ixx;
8 Pz1=Sz1*A;
9 Syz=Sy +Pz1*((W-We)/L);
10 deff("[q12]=f(s)", "q12=(-Syz/Ixx)*((-s^2 +Wa*s) +(A*
      Wa/2))");
11 s=[0:0.01:Wa];
12 fplot2d(s,f);
13 xgrid(3)
14 xtitle('shear flow ', '-s-', '-q12-');
```

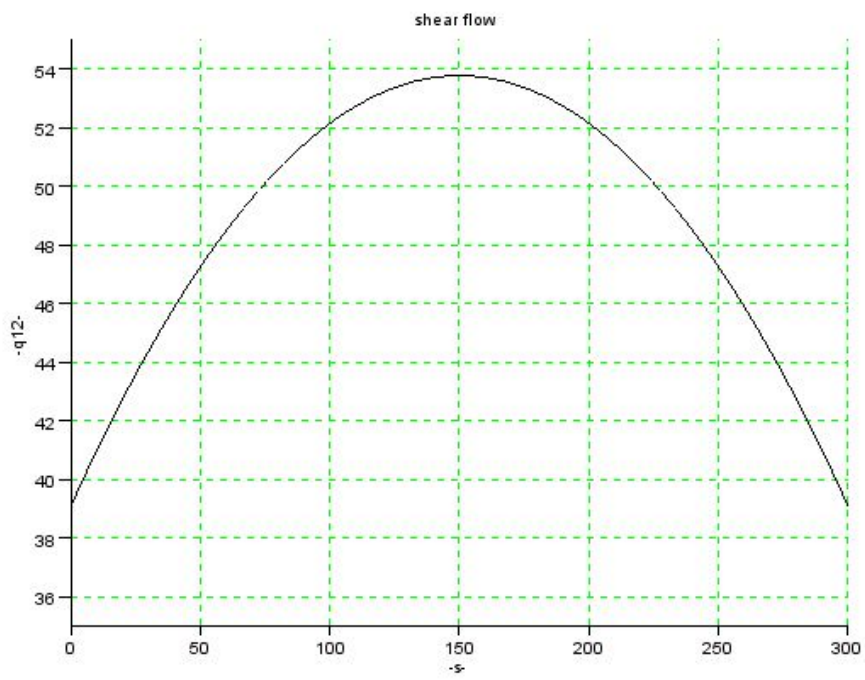


Figure 21.1: Example 1

```
15 datatipToggle();
```

---

check Appendix [AP 24](#) for dependency:

```
21_2data.sci
```

### Scilab code Exa 21.2 Example 2

```
1 pathname=get_absolute_file_path('21_2.sce')
2 filename=pathname+filesep()+ '21_2data.sci'
3 exec(filename)
4 clear
5 Mx=-Sy*(L-Lc); //moment at section
6 L3=(L1*(L-Lc)+ L2*Lc)/L; //leangth of CS
7 B3=(B1*(L-Lc)+ B2*Lc)/L; //breadth of CS
8 Ixx=4*Aco*(B3/2)^2 + 2*Ace*(B3/2)^2;
9 B=[Aco;Ace;Aco;Aco;Ace;Aco];
10 Y=[B3/2;B3/2;B3/2;-B3/2;-B3/2;-B3/2];
11 Dxr=[(L1-L2)/(2*L);0;-(L1-L2)/(2*L);-(L1-L2)/(2*L)
      ;0;(L1-L2)/(2*L)];
12 Dyr=[-(B1-B2)/(2*L);-(B1-B2)/(2*L);-(B1-B2)/(2*L);(
      B1-B2)/(2*L);(B1-B2)/(2*L);(B1-B2)/(2*L)];
13 for i=1:6
14     Pz(i)=(Mx/Ixx)*Y(i)*B(i);
15     Px(i)=Pz(i)*Dxr(i);
16     Py(i)=Pz(i)*Dyr(i);
17     P(i)=(((Px(i))^2 +(Py(i))^2 +(Pz(i))^2)^0.5)*((
      abs(Pz(i)))/Pz(i));
18 end
19 Syw=Sy-sum(Py);
20 qb(1)=0
21 for i=2:4
22     qb(i)=qb(i-1)+(-Syw/Ixx)*B(i-1)*Y(i-1);
23 end
24 qb(5)= qb(3);
25 qb(6)= qb(2);
```

```

26 qs0=((-Sy*L3/2)+(qb(2)*L3*B3*0.5 +qb(3)*L3*B3*0.5 +
      qb(4)*B3*L3*0.5))/(2*L3*B3);
27 q=-qb+qs0*ones(6,1);
28 disp(q,"shear flow (61,12,23,34,45,56)")

```

---

check Appendix [AP 23](#) for dependency:

21\_3data.sci

### Scilab code Exa 21.3 Example 3

```

1  pathname=get_absolute_file_path('21_3.sce')
2  filename=pathname+filesep()+ '21_3data.sci'
3  exec(filename)
4  clear
5  Lc1=Lc+ 0.1*10^3,Lc2=Lc- 0.1*10^3;
6  Mx1=-Sy*(L-Lc1); //moment at section1
7  L31=(L1*(L-Lc1)+ L2*Lc1)/L; //leangth of CS1
8  B31=(B1*(L-Lc1)+ B2*Lc1)/L; //breadth of CS1
9  Mx2=-Sy*(L-Lc2); //moment at section2
10 L32=(L1*(L-Lc2)+ L2*Lc2)/L; //leangth of CS2
11 B32=(B1*(L-Lc2)+ B2*Lc2)/L; //breadth of CS2
12 L3=(L31+L32)/2;
13 B3=(B31+B32)/2;
14 Ixx1=4*Aco*(B31/2)^2 + 2*Ace*(B31/2)^2;
15 Ixx2=4*Aco*(B32/2)^2 + 2*Ace*(B32/2)^2;
16 B=[Aco;Ace;Aco;Aco;Ace;Aco];
17 Y1=[B31/2;B31/2;B31/2;-B31/2;-B31/2;-B31/2];
18 Y2=[B32/2;B32/2;B32/2;-B32/2;-B32/2;-B32/2];
19 Dxr=[(L1-L2)/(2*L);0;-(L1-L2)/(2*L);-(L1-L2)/(2*L)
      ;0;(L1-L2)/(2*L)];
20 Dyr=[-(B1-B2)/(2*L);-(B1-B2)/(2*L);-(B1-B2)/(2*L);(
      B1-B2)/(2*L);(B1-B2)/(2*L);(B1-B2)/(2*L)];
21 for i=1:6
22     Pz1(i)=(Mx1/Ixx1)*Y1(i)*B(i);
23     Px1(i)=Pz1(i)*Dxr(i);

```

```

24     Py1(i)=Pz1(i)*Dyr(i);
25     P1(i)=(((Px1(i))^2 +(Py1(i))^2 +(Pz1(i))^2)^0.5)
        *((abs(Pz1(i)))/Pz1(i));
26     Pz2(i)=(Mx2/Ixx2)*Y2(i)*B(i);
27     Px2(i)=Pz2(i)*Dxr(i);
28     Py2(i)=Pz2(i)*Dyr(i);
29     P2(i)=(((Px2(i))^2 +(Py2(i))^2 +(Pz2(i))^2)^0.5)
        *((abs(Pz2(i)))/Pz2(i));
30 end
31 delP=(P1-P2)/200;
32 q12=(Sy*L3*0.5 +delP(2)*2*L3*B3*0.25 +(delP(2)+delP
        (3))*L3*B3*0.5 +delP(6)*L3*B3*0.5)/(2*L3*B3*0.25
        +2*L3*B3*0.25 +L3*B3*0.5 +L3*B3*0.5);
33 q23=q12-delP(2);
34 q34=q12-(delP(2)+delP(3));
35 q45=q12-(delP(2)+delP(3)+delP(4));
36 q56=q12;
37 q61=q12-delP(6);
38 q=[q12;q23;q34;q45;q56;q61];
39 disp("Shear flow(q12;q23;q34;q45;q56;q61):");
40 printf("\n %f N/mm",q);

```

---



# Chapter 22

## Fuselages

check Appendix [AP 22](#) for dependency:

22\_1data.sci

Scilab code Exa 22.1 Example 1

```
1 pathname=get_absolute_file_path('22_1.sce')
2 filename=pathname+filesep()+ '22_1data.sci'
3 exec(filename)
4 b=(2*%pi*r)/16;
5 for i=1:16
6     angle(i)=(2*%pi/16)*(i-1);
7     y(i)=r*cos(angle(i));
8 end
9 B1=A+ 2*((t*b)/6)*(2 +y(2)/y(1));
10 for i=1:16
11     B(i)=B1;
12     I(i)=B(i)*y(i)*y(i);
13 end
14 Ixx=sum(I);
15 for i=1:16
16     Sz(i)=(Mx*y(i))/Ixx;
17     printf("\n z%f =",i);
```

```
18     printf(" %f N/mm^2",Sz(i))
19 end
```

---

check Appendix [AP 21](#) for dependency:

22\_2data.sci

### Scilab code Exa 22.2 Example 2

```
1  pathname=get_absolute_file_path('22_2.sce')
2  filename=pathname+filesep()+ '22_2data.sci'
3  exec(filename)
4  b=(2*%pi*r)/16;
5  for i=1:16
6      angle(i)=(2*%pi/16)*(i-1);
7      y(i)=r*cos(angle(i));
8  end
9  B1=A+ 2*((t*b)/6)*(2 +y(2)/y(1));
10 for i=1:16
11     B(i)=B1;
12     I(i)=B(i)*y(i)*y(i);
13 end
14 Ixx=sum(I);
15 qs(1)=0;
16 qs(8)=qs(1);
17 for i=2:5
18     qs(i)=((-Sy*B(i)*y(i))/Ixx)+qs(i-1);
19     qs(9-i)=qs(i);
20 end
21 qs1(1)=((-Sy*B(1)*y(1))/Ixx);
22 qs1(8)=qs1(1);
23 for i=2:5
24     qs1(i)=((-Sy*B(18-i)*y(18-i))/Ixx)+qs1(i-1);
25     qs1(9-i)=qs1(i);
26 end
27 Ac=%pi*r*r/16;
```

```
28 qs0=-(((Sy*d)-2*Ac*(sum(qs1)-sum(qs)))/(2*Ac*16));
29 Q=[qs;-qs1];
30 for i=1:16
31     q(i)=Q(i)+qs0;
32     printf("\nq: %f N/mm",q(i))
33 end
```

---

# Chapter 23

## Wings

check Appendix [AP 20](#) for dependency:

23\_1data.sci

Scilab code Exa 23.1 Example 1

```
1 pathname=get_absolute_file_path('23_1.sce')
2 filename=pathname+filesep()+ '23_1data.sci'
3 exec(filename)
4 clear
5 for i=1:6
6     I(i)=B(i)*y(i)*y(i);
7 end
8 Ixx=sum(I);
9 for i=1:6
10    S(i)=(Mx/Ixx)*y(i);
11 end
12 printf("\n z : %f N/mm^2",S);
```

---

check Appendix [AP 19](#) for dependency:

23\_2data.sci

### Scilab code Exa 23.2 Example 2

```
1 pathname=get_absolute_file_path('23_2.sce')
2 filename=pathname+filesep()+ '23_2data.sci'
3 exec(filename)
4 clear
5 for i=1:8
6     ts(i)=(G(i)*t(i))/Gref;
7     del(i)=L(i)/ts(i);
8 end
9 P=[(((del(1)+del(2))/A(1))+del(2)/A(2)) -((del(2)/
    A(1))+((del(2)+del(3)+del(4)+del(5))/A(2))) (del
    (5)/A(2));
10 ((del(1)+del(2))/A(1)) ((del(5)/A(3))-del(2)/A
    (1))) (-del(5)+del(6)+del(7)+del(8))/A(3));
11 2*A(1) 2*A(2) 2*A(3)];
12 X=[0;0;T]
13 q=inv(P)*X;
14 disp("shear flows are");
15 printf("\nqI: %f N/mm",q(1,:));
16 printf("\nqII: %f N/mm",q(2,:));
17 printf("\nqIII: %f N/mm\n",q(3,:));
18 disp("shear stress distribution is(in order 12o,12i
    ,13,24,34,35,46,56)");
19 X1=[q(1,+)/t(1);(q(1,)-q(2,))/t(2);q(2,+)/t(3);q
    (2,+)/t(4);(q(2,)-q(3,))/t(5);
20 q(3,+)/t(6);q(3,+)/t(7);q(3,+)/t(8)]
21 printf("\n %f N/mm^2",X1)
```

---

check Appendix [AP 18](#) for dependency:

23\_3data.sci

### Scilab code Exa 23.3 Example 3

```
1 pathname=get_absolute_file_path('23_3.sce')
```

```

2 filename=pathname+filesep()+ '23_3data.sci '
3 exec(filename)
4 clear
5 for i=1:10
6     ts(i)=t(i)*G(i)/Gref;
7     del(i)=L(i)/ts(i);
8 end
9 for i=1:6
10    I(i)=B(i)*y(i)*y(i);
11 end
12 Ixx=sum(I);
13 for i=1:6
14    q1(i)=(-Sy/Ixx)*B(i)*y(i);
15 end
16 q=[q1(2);q1(1);0;q1(5);q1(3);q1(4)]
17 P=[(((del(4)+del(5)+del(6))/A(1))+del(6)/A(2)))
    -(((del(3)+del(6)+del(10)+del(8))/A(2))+del(6)/A
    (1))) del(8)/A(2);
18 ((del(4)+del(5)+del(6))/A(1)) -(((del(8))/A(3))
    +(del(6)/A(1))) (-((del(2)+del(8)+del(7)+del
    (1)+del(9))/A(3)));
19 2*A(1) 2*A(2) 2*A(3)]
20 X=[-((q(6)*del(5) +q(6)*del(6))/A(1))+((q(4)*del(8)
    +q(5)*del(6))/A(2));
21 -((q(6)*del(5) +q(6)*del(6))/A(1))+((-q(2)*del(9)
    +q(1)*del(8)+q(1)*del(7))/A(3));
22 -q(5)*L(10)*L(5)-q(5)*L(10)*L(6)+q(2)*L(1)*L(9)];
23 X1=inv(P)*X;
24 X2=[X1(1,:);X1(2,:);X1(2,:);X1(3,:);X1(3,:);-q(2)+X1
    (3,:);q(4)-X1(3,:);q(4)-X1(1,:);q(6)+X1(1,:);-q
    (5)-X1(1,:)];
25 dth=(1/(2*Gref))*(((del(4)+del(5)+del(6))/A(1))*X1
    (1,:))-del(6)/A(1))*X1(2,:)+((q(6)*del(5) +q(6)*
    del(6))/A(1));
26 printf("\n d /dz: %f rad/mm\n",dth);
27 disp("shear flow distribution is(in order q34,q23,
    q87,q12,q56,q61,q57,q72,q48,q83)");
28 printf("\n %f N/mm",X2)

```

---

check Appendix [AP 17](#) for dependency:

23\_4data.sci

#### Scilab code Exa 23.4 Example 4

```
1 pathname=get_absolute_file_path('23_4.sce')
2 filename=pathname+filesep()+ '23_4data.sci'
3 exec(filename)
4 clear
5 y1=0.5*[W1;W1;W1;-W1;-W1;-W1];
6 y2=0.5*[W2;W2;W2;-W2;-W2;-W2];
7 x1=[0;L12;L12+L11;L12+L11;L12;0];
8 x2=[0;L22;L22+L21;L22+L21;L22;0];
9 Li=[L12;L11;W1;L11;L12;W1;W1];
10 for i=1:6;
11     I1(i)=B(i)*y1(i)*y1(i);
12     del(i)=Li(i)/t(3);
13 end
14 del(7)=Li(7)/t(3);
15 Ixx=sum(I1);
16 dely=(y1-y2);
17 delx=(x1-x2);
18 epr=[L12;0;L11;L11;0;L12];
19 nr=abs(y1);
20 for i=1:6
21     Pz(i)=(Mx/Ixx)*B(i)*y1(i);
22     Py(i)=Pz(i)*dely(i)/L;
23     Px(i)=Pz(i)*delx(i)/L;
24     Pr(i)=((Px(i)^2 +Py(i)^2 +Pz(i)^2)^0.5)*(y1(i)/
        abs(y1(i)));
25     Pxn(i)=-abs(Px(i)*nr(i));
26     Pyep(i)=Py(i)*epr(i);
27 end
28 Pyep(6)=-Pyep(i);
```

```

29 Sxw=-sum(Px);
30 Syw=Sy-sum(Py);
31 qb=[0;0;(-Syw/Ixx)*(B(3)*y1(3));0;0;(-Syw/Ixx)*(B(6)
      *y1(6));(-Syw/Ixx)*B(5)*y1(5)];
32 qb1=0;
33 for i=1:7
34     qb1=qb(i)*del(i) +qb1;
35 end
36 A1=L11*W1;
37 A2=L12*W1;
38 P=[((del(2)+del(3)+del(4)+del(7))/A1)+(del(7))/A2
      -((del(7)/A1)+((del(1)+del(5)+del(6)+del(7))/A2))
      ;
39     2*A1    2*A2];
40 X=[(qb1/(3*A1))+(qb1/(3*A2));-(qb(3)*W1*L12 +qb(6)*
      W1*L11)-sum(Pxn)+sum(Pyep)];
41 qs=inv(P)*X;
42 M1=-[qs(2);qs(1);qs(1);qs(1);qs(2);qs(2);qs(1)-qs(2)
      ];
43 q=qb+M1;
44 disp("shear flow (q12;q23;q34;q45;q56;q61;q52):");
45 printf("\n %f N/mm",q)

```

---

check Appendix [AP 16](#) for dependency:

23\_6data.sci

### Scilab code Exa 23.6 Example 6

```

1 pathname=get_absolute_file_path('23_6.sce')
2 filename=pathname+filesep()+ '23_6data.sci'
3 exec(filename)
4 clear
5 A=L1*B1;

```



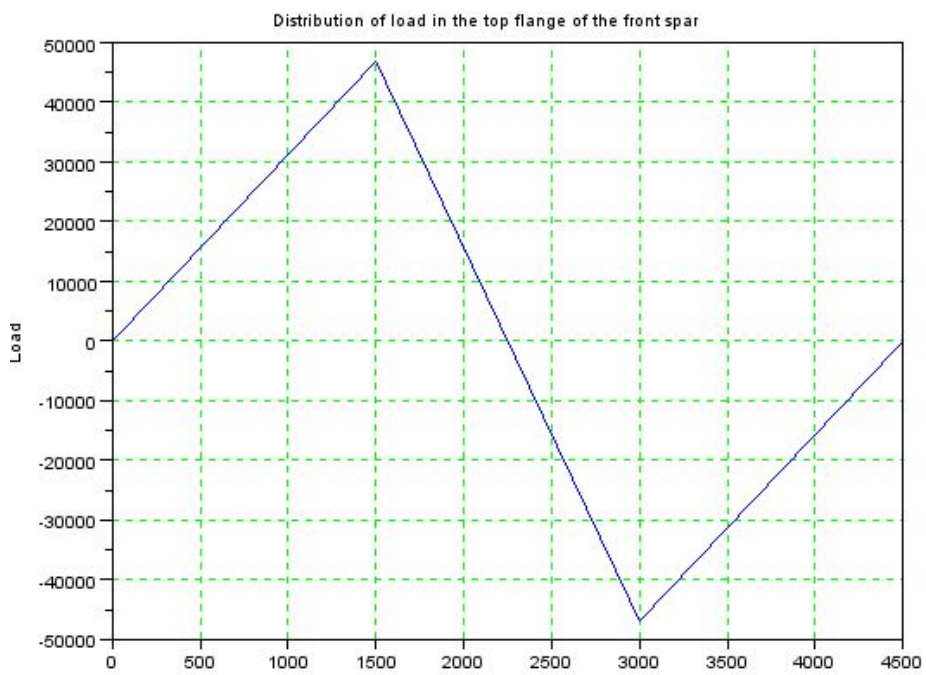


Figure 23.1: Example 6

```

6 q1=T/(2*A);
7 S=T/B1;
8 q1=S/L1;
9 P=S*(L/2)/L1;
10 X=[L -L;A A];
11 X1=[P;T];
12 q=[q1; inv(X)*X1];
13 X2=[0;L*q(2)-L*q(3);-L*q(2)+L*q(3);0];
14 Y=[0;1500;3000;4500];
15 plot(Y,X2);
16 xgrid(3);
17 xtitle('Distribution of load in the top flange of
        the front spar ',' ','Load')
18 datatipToggle();
19 printf("\nq1: %f N/mm",q(1))
20 printf("\nq2: %f N/mm",q(2))
21 printf("\nq3: %f N/mm",q(3))

```

---

# Chapter 24

## Fuselage frames and wing ribs

check Appendix [AP 15](#) for dependency:

24\_1data.sci

Scilab code Exa 24.1 Example 1

```
1 pathname=get_absolute_file_path('24_1.sce')
2 filename=pathname+filesep()+ '24_1data.sci'
3 exec(filename)
4 clear
5 P=[GH -GH;DK KH],X=[L1*sin(theta);L1*cos(theta)];
6 q=inv(P)*X;
7 q(3)=L1*cos(theta)/(DK+KH);
8 q(4)=(L1*cos(theta)+L2)/(DK+KH);
9 PA=GH*q(1) +FG*q(3) +EF*q(4);
10 PE=-GH*q(2) -FG*q(3) -EF*q(4);
11 X1=[GH*q(1)+FG*q(3)+EF*q(4);GH*q(1)+FG*q(3);GH*q(1)
      ;0];
12 X2=[-GH*q(2)-FG*q(3)-EF*q(4);-GH*q(2)-FG*q(3);-GH*q
      (2);0];
13 Y=[0;EF;EF+FG;EF+FG+GH];
```

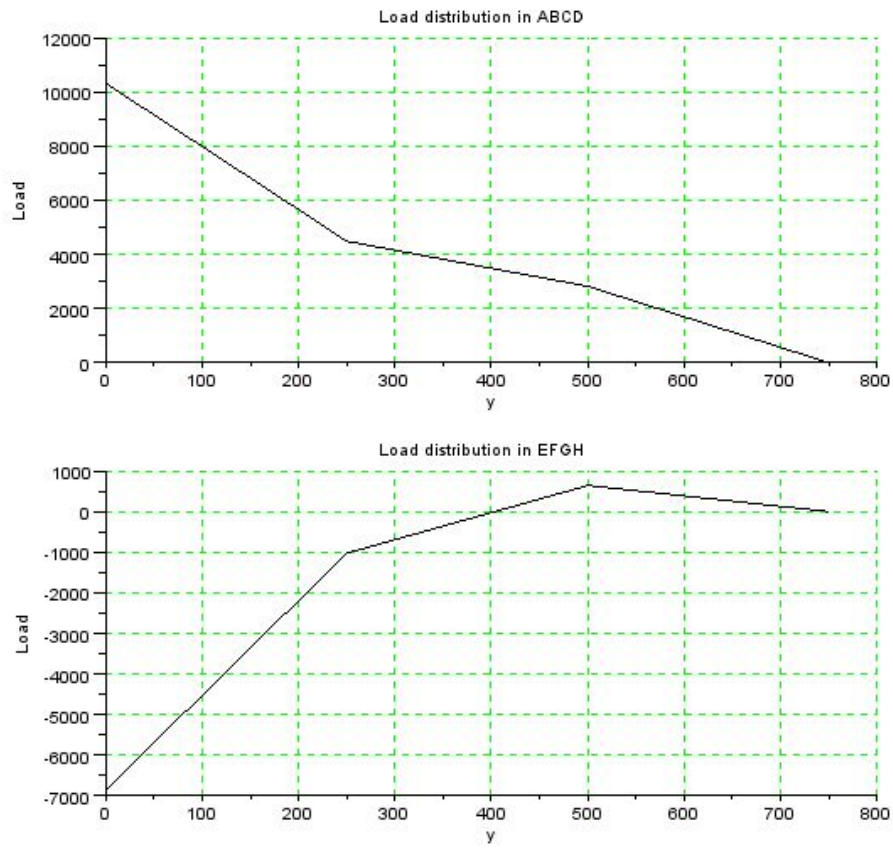


Figure 24.1: Example 1

```

14 subplot(2,1,1)
15 plot2d(Y,X1)
16 xgrid(3)
17 xtitle('Load distribution in ABCD','y','Load')
18 subplot(2,1,2)
19 plot2d(Y,X2)
20 xgrid(3)
21 xtitle('Load distribution in EFGH','y','Load')
22 datatipToggle();
23 printf("\nq1: %f N/mm",q(1));
24 printf("\nq2: %f N/mm",q(2));
25 printf("\nq3: %f N/mm",q(3));
26 printf("\nq4: %f N/mm",q(4));
27 printf("\nPA: %f N",PA);
28 printf("\nPE: %f N",PE);
29 printf("\nclick on the point to view its coordinate
    on the plot");

```

---

check Appendix [AP 14](#) for dependency:

24\_2data.sci

### Scilab code Exa 24.2 Example 2

```

1 pathname=get_absolute_file_path('24_2.sce')
2 filename=pathname+filesep()+'24_2data.sci'
3 exec(filename)
4 clear
5 P=[2*L11 -2*L11 0;0 -L11 L11;2*A2 2*(A1+A2) 0],X=[L1
    ;L2;440000];
6 q=inv(P)*X;
7 //actual X is X=[L1;L2;-L2*L11],it leads to wrong
    answers than book;
8 Sy1=-(q(2))*L11;
9 Px4= 2*A1*-(q(2))/L11;
10 Py2= Px4*tan(theta);

```

```

11 q1= (Sy1- 2*Py2)/L11;
12 P2= (Px4*Px4 +Py2*Py2)^0.5;
13 P5= 2*((A1+A22)*(-q(2)) - A21*q(1))/L12;
14 q2= ((-q(2))*L11 +(-q(2))*0.5*(L12-L11) -q(1)*0.5*(
      L12-L11))/L12;
15 q31= (q2*L12 +L2)/L12;
16 M3= 2*((A1+A2)*(-q(2)) -A2*q(1))+ L2*L11;
17 Px1=M3/L11;
18 Py1=Px1*tan(theta);
19 P1=(Px1*Px1+ Py1*Py1)^0.5;
20 q32=((L2+ L11*(-q(2))) -(2*Py1))/L11;
21 printf("\nq12: %f N/mm",q(1));
22 printf("\nq23: %f N/mm",q(2));
23 printf("\nq31: %f N/mm",q(3));
24 printf("\nP2= P4= %f N",P2);
25 printf("\nP5= P6= %f N",P5);
26 printf("\nP1= P3= %f N",P1);
27 printf("\nq1: %f N/mm",q1);
28 printf("\nq2: %f N/mm",q2);
29 printf("\nq3: %f N/mm",q31);
30 printf("\nshear flow q3 in the web: %f N/mm",q32)

```

---

# Chapter 25

## Laminated composites

check Appendix [AP 13](#) for dependency:

25\_1data.sci

Scilab code Exa 25.1 Example 1

```
1 pathname=get_absolute_file_path('25_1.sce')
2 filename=pathname+filesep()+ '25_1data.sci'
3 exec(filename)
4 clear
5 A=(L1*(Bc+Be1+Be2));
6 E1= ((Ec*L1*Bc)+(Ee*L1*(Be1+Be2)))/A;
7 S1=Load/A;
8 e1=S1/E1;
9 dell=e1*L;
10 v1= ((vc*L1*Bc)+(ve*L1*(Be1+Be2)))/A;
11 et=-e1*v1;
12 delt=-et*(Bc+Be1+Be2);
13 Se=e1*Ee;
14 Sc=e1*Ec;
15 printf("\nlengthening of the bar: %f mm",dell);
16 printf("\nreduction in thickness: %f mm",delt);
17 printf("\n m (epoxy): %f N/mm^2",Se);
```

```
18 printf("\n f(carbon): %f N/mm^2",Sc);
```

---

check Appendix [AP 12](#) for dependency:

25\_2data.sci

### Scilab code Exa 25.2 Example 2

```
1 pathname=get_absolute_file_path('25_2.sce')
2 filename=pathname+filesep()+ '25_2data.sci'
3 exec(filename)
4 clear
5 vt1=vlt*(Et/E1);
6 e1=(S1/E1)-(vt1*S2/Et);
7 e2=(S2/Et)-(vlt*S1/E1);
8 gammalt=S3/Glt; // lt
9 printf("\n t1:%f ",vt1);
10 printf("\n l:%f ",e1);
11 printf("\n t:%f ",e2);
12 printf("\n lt:%f ",gammalt);
```

---

check Appendix [AP 11](#) for dependency:

25\_3data.sci

### Scilab code Exa 25.3 Example 3

```
1 pathname=get_absolute_file_path('25_3.sce')
2 filename=pathname+filesep()+ '25_3data.sci'
3 exec(filename)
4 clear
5 s11=1/E1;
6 s22=1/Et;
7 s12=-vlt/E1;
```



```

8 s33=1/Glt;
9 m=cos(theta),n=sin(theta);
10 P=[(s11*m^4)+(s22*n^4)+(2*s12*m*m*n*n)+(s33*m*m*n*n)
      (m*m*n*n)*(s11+s22-s33)+(m^4 +n^4)*s12 0;
11     (m*m*n*n)*(s11+s22-s33)+(m^4 +n^4)*s12 (s11*n^4)
      +(s22*m^4)+(2*s12*m*m*n*n)+(s33*m*m*n*n) 0;
12     ((-n*m^3 +m*n^3)*(2*s12 +s33))-(2*s22*m*n^3)+(2*n
      *s11*m^3) ((n*m^3 -m*n^3)*(2*s12 +s33))+(2*s11
      *m*n^3)-(2*n*s22*m^3) 0];
13 X=[S1;S2;0];
14 E=P*X;
15 printf("\n x : %f ",E(1));
16 printf("\n y : %f ",E(2));
17 printf("\n xy :%f ",E(3));

```

---

check Appendix [AP 10](#) for dependency:

25\_4data.sci

#### Scilab code Exa 25.4 Example 4

```

1 pathname=get_absolute_file_path('25_4.sce')
2 filename=pathname+filesep()+ '25_4data.sci'
3 exec(filename)
4 clear
5 X1=a*tb*Ez1;
6 X2=b*ta*Ez2;
7 ez=Load/(2*X1+X2);
8 P1=ez*X1;
9 P2=ez*X2;
10 printf("\nP( flanges) %f N",P1);
11 printf("\nP(web) %f N",P2);

```

---

check Appendix [AP 9](#) for dependency:

25\_5data.sci

### Scilab code Exa 25.5 Example 5

```
1 pathname=get_absolute_file_path('25_5.sce')
2 filename=pathname+filesep()+ '25_5data.sci'
3 exec(filename)
4 clear
5 Ixx=(2*Ez1*a*tb*(b/2)^2) +(Ez2*ta*b^3)/12;
6 Iyy=(Ez1*tb*(2*a)^3)/12;
7 Ixy= Ez1*a*tb*a*(b/2) +Ez1*a*tb*(-a)*(-b/2);
8 P1=(-Mx*Ixy)/(Ixx*Iyy-Ixy*Ixy);
9 P2=(Mx*Iyy)/(Ixx*Iyy-Ixy*Ixy);
10 function[S1]=Sz1(x,y), //stress in flanges
11     S1=Ez1*(P1*x+P2*y),
12 endfunction
13 function[S2]=Sz2(x,y), //stress in web
14     S2=Ez2*(P1*x+P2*y),
15 endfunction
16 X=[Sz1(a,0.5*b);Sz1(0,0.5*b);Sz1(0,-0.5*b);Sz1(-a
    ,-0.5*b);Sz2(0,0.5*b);Sz2(0,-0.5*b)];
17 printf("\nmaximum direct stress in the beam cross-
    section is: %f N/mm^2",max(X));
```

---

check Appendix [AP 8](#) for dependency:

25\_6data.sci

### Scilab code Exa 25.6 Example 6

```
1 pathname=get_absolute_file_path('25_6.sce')
2 filename=pathname+filesep()+ '25_6data.sci'
```

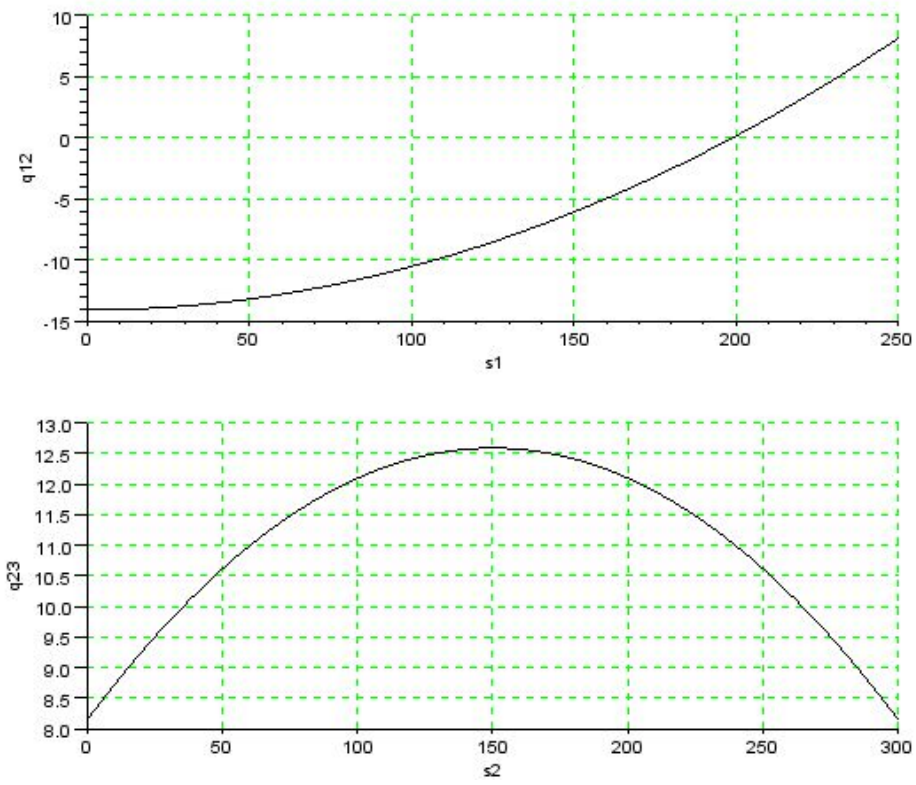


Figure 25.1: Example 6

```

3  exec(filename)
4  clear
5  Ixx=((2*E12*t12*((L23/(2*L12))^2)*L12^3)+(E23*t23*
      L23^3))/12;
6  alpha=asin(L23*0.5/L12);
7  function[qb12]=qb12x(s1)
8      qb12= 0.5*(t12*sin(alpha)*E12*Sy/Ixx)*s1^2;
9  endfunction
10 function[qb23]=qb23x(s2)
11     qb23=((-E23*t23*Sy/Ixx)*(-0.5*L23*s2 +0.5*s2^2))
        +qb12x(L12);
12 endfunction
13 funcprot();
14 qs0=((Sy*L12)+(L23*L12*qb12x(L12)/3))/(L12*L23);
15 function[q12]=q12x(s1)
16     q12=qb12x(s1)-qs0;
17 endfunction
18 function[q23]=q23x(s2)
19     q23=qb23x(s2)-qs0;
20 endfunction
21 s1=linspace(0,L12,10*L12);
22 s2=linspace(0,L23,10*L23);
23 q12=feval(s1,q12x);
24 q23=feval(s2,q23x);
25 subplot(2,1,1)
26 plot2d(s1,q12);
27 xgrid(3)
28 xtitle('','s1','q12')
29 subplot(2,1,2)
30 plot2d(s2,q23);
31 xgrid(3)
32 xtitle('','s2','q23')
33 datatipToggle();
34 printf("\n click on the point to view its coordinate
      on plot")

```

---

check Appendix [AP 7](#) for dependency:

25\_7data.sci

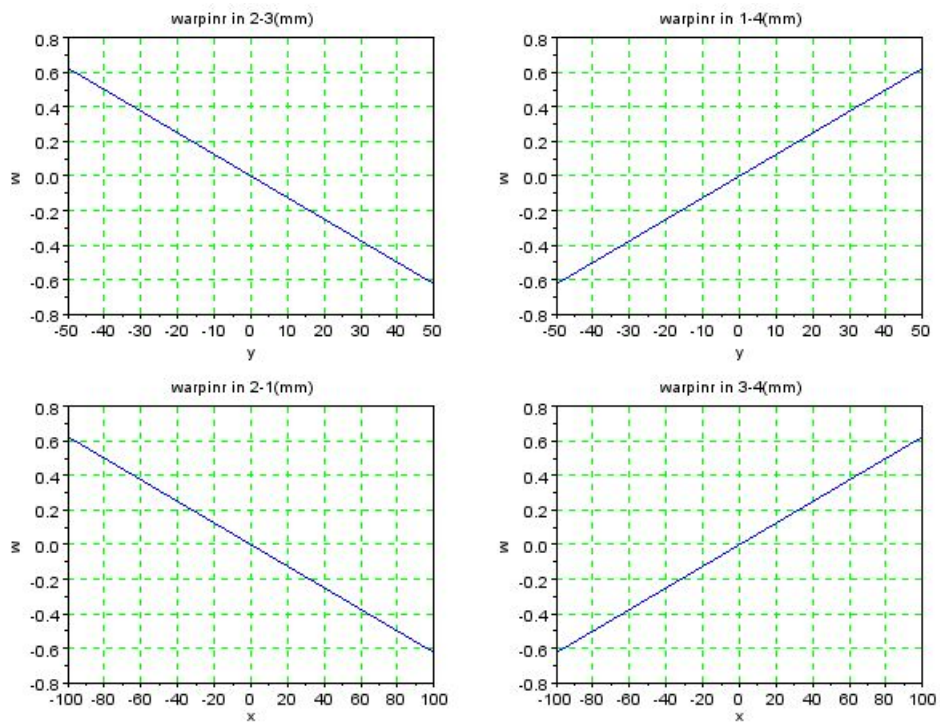


Figure 25.2: Example 7

### Scilab code Exa 25.7 Example 7

```

1 pathname=get_absolute_file_path('25_7.sce')
2 filename=pathname+filesep()+ '25_7data.sci'
3 exec(filename)
4 clear
5 A=1*b;
6 q=T/(2*A);
7 P=(2*b/(t1*Gc))+(2*l/(t2*Gw));
8 w=q*((0.5*l/(Gw*t2))- 0.25*P);

```

```

 9 X1=0.5*[1,-1],Y1=[w,-w];
10 X2=0.5*[1,-1],Y2=[-w,w];
11 X3=0.5*[b,-b],Y3=[w,-w];
12 X4=0.5*[b,-b],Y4=[-w,w];
13 subplot(2,2,1)
14 plot(X1,Y1),xgrid(3),xtitle('warpinr in 2-3(mm)', 'y'
    , 'w')
15 subplot(2,2,2)
16 plot(X2,Y2),xgrid(3),xtitle('warpinr in 1-4(mm)', 'y'
    , 'w')
17 subplot(2,2,3)
18 plot(X3,Y3),xgrid(3),xtitle('warpinr in 2-1(mm)', 'x'
    , 'w')
19 subplot(2,2,4)
20 plot(X4,Y4),xgrid(3),xtitle('warpinr in 3-4(mm)', 'x'
    , 'w')
21 datatipToggle();
22 printf("\nW1: %f mm",w);
23 printf("\nclick on the point to view its coordinate
    on plot")

```

---

check Appendix [AP 6](#) for dependency:

25\_8data.sci

### Scilab code Exa 25.8 Example 8

```

1 pathname=get_absolute_file_path('25_8.sce')
2 filename=pathname+filesep()+ '25_8data.sci'
3 exec(filename)
4 clear
5 GJ=2*G1*a*(t1^3)/3 +G2*b*(t2^3)/3;
6 dtheta=T/GJ;
7 tmax12=2*G1*(t1/2)*dtheta;

```

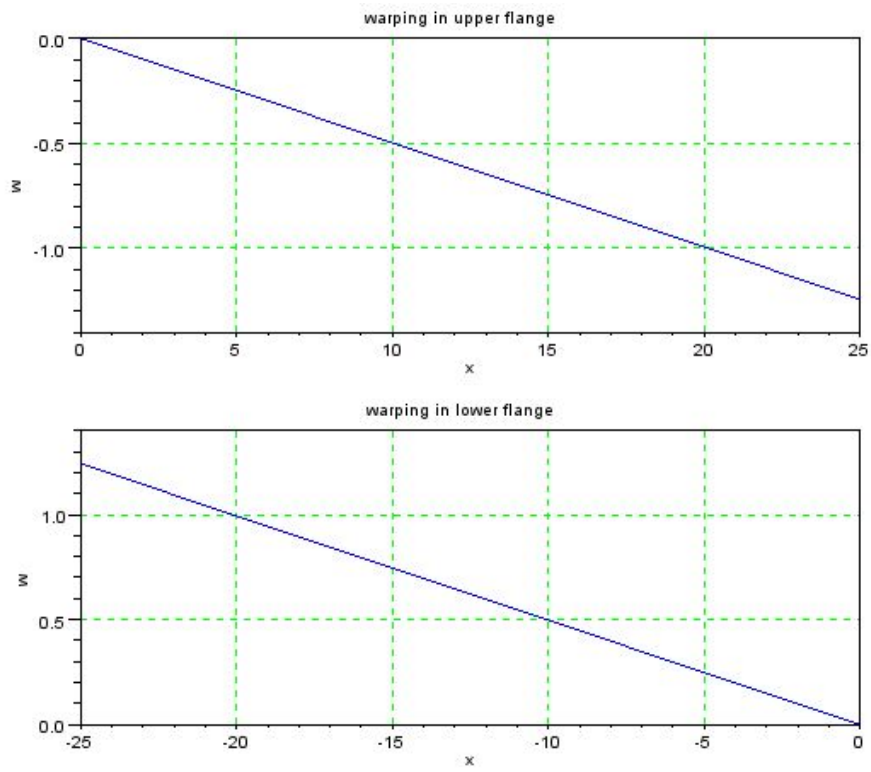


Figure 25.3: Example 8

```

8 tmax23=2*G2*(t2/2)*dtheta;
9 maximum=tmax23;
10 if(tmax12>tmax23) then
11     maximum=tmax12;
12 end
13 printf("\nmaximum shear stress: %f N/mm^2",maximum);
14 w1=-2*(0.5*a*b/2)*dtheta;
15 printf("\nw1: %f mm",w1);
16 X=[0;a],Y=[0,w1],X1=-X,Y1=-Y;
17 subplot(2,1,1),plot(X,Y),xgrid(3),xtitle('warping in
    upper flange','x','w');
18 subplot(2,1,2),plot(X1,Y1),xgrid(3),xtitle('warping
    in lower flange','x','w');
19 datatipToggle();
20 printf("\nclick on the point to view its coordinate
    on plot");

```

---



# Chapter 26

## closed section beams

check Appendix [AP 5](#) for dependency:

26\_1data.sci

Scilab code Exa 26.1 Example 1

```
1 pathname=get_absolute_file_path('26_1.sce')
2 filename=pathname+filesep()+ '26_1data.sci'
3 exec(filename)
4 clear
5 L41=L23*cos(asin((L12-L34)/L23));
6 t41=t23;
7 C=[0;cos(asin((L12-L34)/L23));0;1];
8 S=[1;sin(asin((L12-L34)/L23));1;0];
9 P=[1 0 0 0 0 -t12*G 0;
10   0 1 0 0 t23*G*cos(asin((L12-L34)/L23)) t23*G*sin(
11     asin((L12-L34)/L23)) -t23*G*L12*cos(asin((L12-
12     L34)/L23));
13   0 0 1 0 0 t34*G -t34*G*L23*cos(asin((L12-L34)/L23
14     ));
15   0 0 0 1 -t41*G 0 0;
16   0 1 0 -1 0 0 0;
17   L12 -L23*sin(asin((L12-L34)/L23)) -L34 0 0 0 0;
```

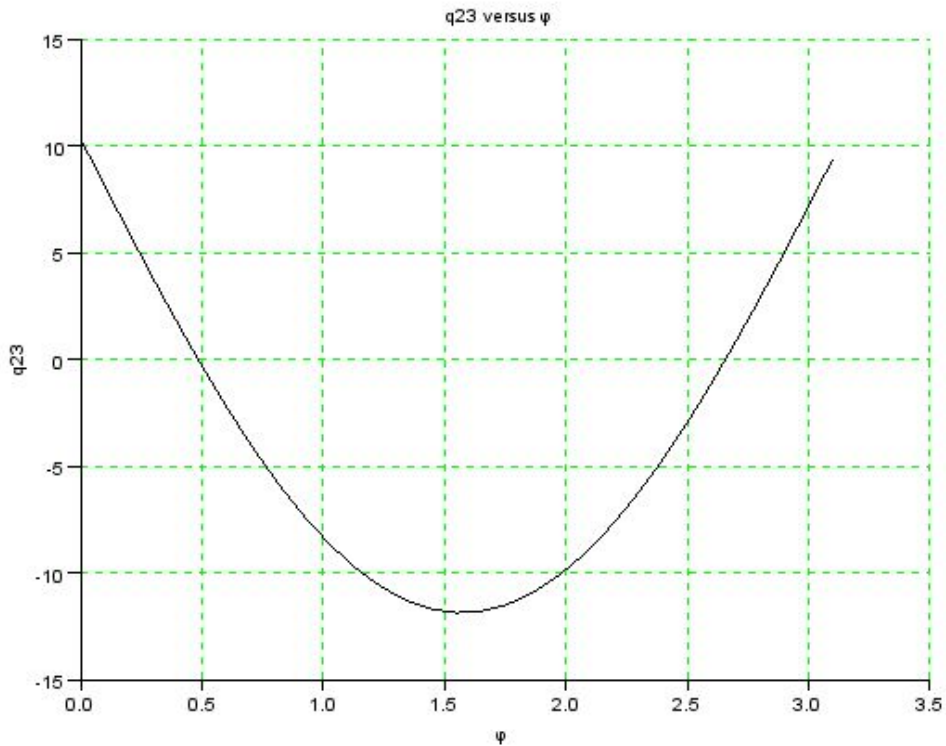


Figure 26.1: Example 2

```

15      0 L23*L12*cos(asin((L12-L34)/L23)) L34*L23*cos(
      asin((L12-L34)/L23)) 0 0 0 0];
16 X=[0;0;0;0;0;0;Load;Load*x];
17 q=inv(P)*X;
18 printf("\n 1 2 : %f N/mm^2", q(1)/t12);
19 printf("\n 2 3 : %f N/mm^2", q(2)/t23);
20 printf("\n 3 4 : %f N/mm^2", q(3)/t34);
21 printf("\n 4 1 : %f N/mm^2", q(4)/t41);

```

---

check Appendix [AP 4](#) for dependency:

26\_2data.sci

### Scilab code Exa 26.2 Example 2

```
1 pathname=get_absolute_file_path('26_2.sce')
2 filename=pathname+filesep()+ '26_2data.sci'
3 exec(filename)
4 clear
5 du=0;
6 P=[1 0 0 G*t*R;
7     0 1 -G*t 2*R*G*t;
8     0 0 1.79 -R
9     0 0 -0.13 R];
10 X=[0;0;Load/(2*R*G*t);Load/((-0.5*pi -6)*G*R*t)];
11 q=inv(P)*X;
12 printf("\nq12 = q34 = %f N/mm",q(1));
13 printf("\nq41= %f N/mm",q(2));
14 function [q23]=f(phi)
15     q23=-R*G*t*q(4) -G*t*sin(phi)*q(3);
16 endfunction
17 phi=linspace(0,%pi,%pi*10);
18 q23=feval(phi,f);
19 plot2d(phi,q23);
20 xgrid(3),xtitle('q23 versus ',' ','q23');
21 datatipToggle();
```

---

check Appendix [AP 3](#) for dependency:

26\_3data.sci

### Scilab code Exa 26.3 Example 3

```
1 pathname=get_absolute_file_path('26_3.sce')
2 filename=pathname+filesep()+ '26_3data.sci'
```

```

3  exec(filename)
4  clear
5  Tr=T*L1/2;
6  mu=(8*G*t/(A*E*(b+a)))^0.5;
7  L=L1/2;
8  k1=((T*(b-a)*10^3)/(8*a*b*G*t));
9  k2=1/(mu*cosh(mu*L));
10 k3=((4*(b-a))/(a*b*(b+a)));
11 k4=(2*T*(10^3)/(a*b*G*t*(b+a)));
12 function [th]=f(z)
13     w=(k1*((k2*sinh(mu*z))-z));
14     F=((k1*k3 +k4)*L*L*0.5 -(k1*k2*k3/mu)*cosh(mu*L)
        );
15     th=(k1*k2*k3/mu)*cosh(mu*z) -(k1*k3 +k4)*z*z*0.5
        + F;
16 endfunction
17 funcprot();
18 printf("\nangle of twist at mid-span    : %f rad",f
        (0));

```

---

check Appendix [AP 2](#) for dependency:

26\_4data.sci

#### Scilab code Exa 26.4 Example 4

```

1  pathname=get_absolute_file_path('26_4.sce')
2  filename=pathname+filesep()+ '26_4data.sci'
3  exec(filename)
4  B=((a*t2)/6)+((b*t1)/18)*3;
5  A=((b*t1)/18)*6;
6  L1=Load/4;
7  x=L1/a;
8  d=b/3;

```

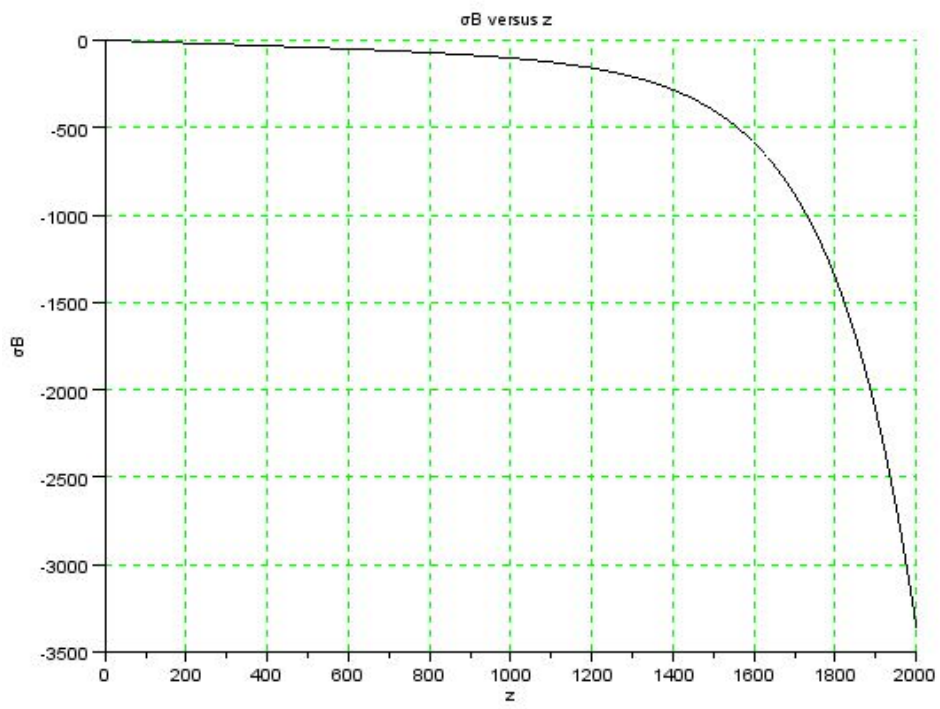


Figure 26.2: Example 4

```

9 E=1,G=GE;
10 mu=((G*t1)/(d*E))*((A+B)/(A*B))^0.5;
11 D=(-x*A)/((A+B)*mu*cosh(L*0.5*mu));
12 function[Sb]=f(z)
13     Sb=((D/B)*sinh(mu*z)) -(x/(A+B))*z;
14 endfunction
15 funcprot()
16 z=linspace(0,L,10*L);
17 Sb=feval(z,f);
18 plot2d(z,Sb);
19 xgrid(3),xtitle(' B versus z ','z ',' B ');
20 datatipToggle()
21 printf("\n click on the point to view its coordinate
    on the plot");

```

---

# Chapter 27

## Open section beams

check Appendix [AP 1](#) for dependency:

27\_2data.sci

Scilab code Exa 27.2 Example 2

```
1 pathname=get_absolute_file_path('27_2.sce')
2 filename=pathname+filesep()+ '27_2data.sci'
3 exec(filename)
4 clear
5 TR=((t*a^3 *b^2)*(2*b +a))/(12*(b+ 2*a));
6 J=(1/3)*(2*a +b)*t^3;
7 mu=((G*J)/(E*TR))^0.5;
8 Ar1=(-3/4)*(a*b/4);
9 Ar2=(1/4)*(a*b/4);
10 MT=P*2*Ar2;
11 X=-MT/(E*TR);
12 D=X/(mu*cosh(mu*L));
13 F=-D*cosh(0)/mu;
14 function [theta]=th(z) //
15     theta=((D/mu)*cosh(mu*z))+F;
```

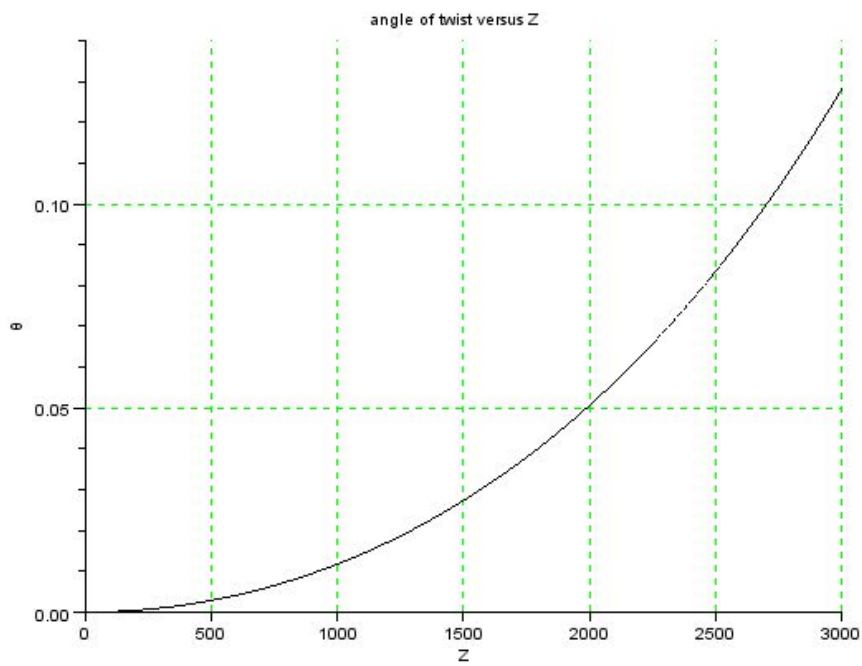


Figure 27.1: Example 2



```

16 endfunction
17 z=linspace(0,L,10*L);
18 theta=feval(z,th);
19 plot2d(z,theta);
20 xgrid(3)
21 xtitle('angle of twist versus Z','Z',' ');
22 datatipToggle();
23 printf("\n (top): %f rad",th(L));
24 MT0=-E*TR*X/3;
25 A=(2*a +b)*t;
26 Sz1=(P/A)+(MT0/TR)*2*Ar1; // z 1
27 Sz2=(P/A)+(MT0/TR)*2*Ar2; // z 2
28 printf("\n z 1 = z 4 = %f N/mm^2",Sz1)
29 printf("\n z 3 = z 2 = %f N/mm^2",Sz2)

```

---

# Appendix

## Scilab code AP 1 Example 27.2 data

```
1 a=100; //cross section dimation ,given ,in mm
2 b=200; //cross section dimation ,given ,in mm
3 t=5; //thickness ,given ,in mm
4 L=3000; //length ,given ,in mm
5 E=200000; //given ,in N/mm^2
6 G=0.36*200000; //given ,in N/mm^2
7 P=-100*10^3; //load ,given ,in N
```

---

## Scilab code AP 2 Example 26.4 data

```
1 t1=2;
2 t2=3;
3 a=100;
4 b=600;
5 L=2000; //length
6 Load=20*10^3; //given in N
7 GE=0.36; // G/E
```

---

## Scilab code AP 3 Example 26.3 data

```
1 L1=5000; //given ,in mm
2 A=800; //booms area ,given ,in mm^2
3 G=20000; //given ,in N/mm^2
4 E=G/0.36; //given
5 T=20; //torque loading ,given ,in N.m/mm
6 t=1; //wall thickness ,given ,in mm
```

```
7 a=500;  
8 b=200;
```

---

**Scilab code AP 4** Example 26.2 data

```
1 R=200; //given , in mm  
2 Load=20000; //given , in N  
3 G=70000; //in N/mm2  
4 t=2; //thickness in mm
```

---

**Scilab code AP 5** Example 26.1 data

```
1 L12=375; //given , in mm  
2 L23=500; //given , in mm  
3 L34=125; //given , in mm  
4 t12=1.6; //given , in mm  
5 t23=1; //given , in mm  
6 t34=1.2; //given , in mm  
7 x=100; //given , in mm  
8 Load=22000; //given , in mm  
9 G=70000; //in N/mm2
```

---

**Scilab code AP 6** Example 25.8 data

```
1 T=10*103; //given , in N.mm  
2 G1=20000; //laminare shear modulus of flanges , given ,  
   in N/mm2  
3 G2=15000; //laminare shear modulus of web , given , in N/  
   mm2  
4 a=25;  
5 b=50;  
6 t1=1.5;  
7 t2=2.5;
```

---

**Scilab code AP 7** Example 25.7 data

```
1 T=10*106; //Torque , given , in N.mm
```

```
2 l=100; //given , in mm
3 b=200; //given , in mm
4 t1=2; //given , in mm
5 t2=1; //given , in mm
6 Gw=35000; //given , in N/mm^2
7 Gc=20000; //given , in N/mm^2
```

---

**Scilab code AP 8** Example 25.6 data

```
1 E23=20000; //laminat e Young s modulus of 23, given ,
   in N/mm^2
2 E12=45000; //laminat e Young s modulus of 12, given ,
   in N/mm^2
3 L12=250; //length of 12, given , in mm
4 L23=300; //length of 23, given , in mm
5 t12=2; //thickness of 12, given , in mm
6 t23=1.5; //thickness of 23, given , in mm
7 Sy=2*10^3; //load
```

---

**Scilab code AP 9** Example 25.5 data

```
1 a=50; //cross section dimension , given , in mm
2 b=100; //cross section dimension , given , in mm
3 ta=1; //thickness , given , in mm
4 tb=2; //thickness , given , in mm
5 Ez1=50000; // Young s modulus for the flange , given ,
   in N/mm^2
6 Ez2=15000; // Young s modulus for the web, given , in N
   /mm^2
7 Mx=1*10^6;
```

---

**Scilab code AP 10** Example 25.4 data

```
1 a=100;
2 b=150;
3 ta=1;
4 tb=2;
```

```
5 Ez1=60000;
6 Ez2=20000;
7 Load=40*10^3;
```

---

**Scilab code AP 11** Example 25.3 data

```
1 S1=60; //stress parallel to the x reference axis ,
      given ,in N/mm^2
2 S2=40; //stress perpendicular to the x reference axis
      ,given ,in N/mm^2
3 theta=45*(%pi/180); //given
4 E1=150000; //given ,in N/mm^2
5 Et=90000; //given ,in N/mm^2
6 Glt=5000; //given ,in N/mm^2
7 vlt=0.3; //given
```

---

**Scilab code AP 12** Example 25.2 data

```
1 S1=50; //longitudnal direct stress ,given ,in N/mm^2
2 S2=25; //transverse direct stress ,given ,in N/mm^2
3 S3=40; //shear stress ,given ,in N/mm^2
4 E1=120000; //given ,in N/mm^2
5 Et=80000; //given ,in N/mm^2
6 Glt=5000; //given ,in N/mm^2
7 vlt=0.3; //given
```

---

**Scilab code AP 13** Example 25.1 data

```
1 Ee=5000; //modulus of epoxy ,given ,in N/mm^2
2 Ec=200000; //modulus of carbon ,given ,in N/mm^2
3 ve=0.2; //poission 's ratio of epoxy
4 vc=0.3; //poission 's ratio of carbon
5 L=500; //length of bar ,given ,in mm
6 L1=80; //length of cross section ,given ,in mm
7 Be1=20; //width of first section of epoxy ,given ,in mm
8 Be2=20; //width of other section of epoxy ,given ,in mm
9 Bc=10; //width of section of carbon ,given ,in mm
10 Load=100*10^3; //axial tensile load ,given ,in N
```

---

**Scilab code AP 14** Example 24.2 data

```
1 L11=300;
2 L12=320;
3 L1=12000;
4 L2=15000;
5 A1=50000;
6 A2=95000;
7 A21=49000;
8 A22=A2-A21;
9 theta=15*(%pi/180);
```

---

**Scilab code AP 15** Example 24.1 data

```
1 GH=250; //given in mm
2 DK=200; //given in mm
3 KH=100; //given in mm
4 FG=250; //given in mm
5 EF=250; //given in mm
6 L1=4000; //given in N
7 L2=5000; //given in N
8 theta=60*(%pi/180); //given
```

---

**Scilab code AP 16** Example 23.6 data

```
1 T=10*10^6; //given , in N.mm
2 L1=200; //Cross section dimation ,given ,in mm
3 B1=800; //Cross section dimation ,given ,in mm
4 L=1500; //in mm
```

---

**Scilab code AP 17** Example 23.4 data

```
1 B=[600;900;600;600;900;600]; //matrix having the
   values of B
2 t=[0.8;0.8;1;0.8;0.8;1;1]; //thickness ,in order
   -12,23,34,45,56,61,25;
```

```

3 L11=200; //leangth 1 of built in end ,given in mm
4 L12=400; //leangth 2 of built in end ,given in mm
5 W1=180; //breadth of built in end ,given in mm
6 L21=150; //leangth 1 of open end ,given in mm
7 L22=300; //leangth 2 of open end ,given in mm
8 W2=80; //breadth of open end ,given in mm
9 L=1.2*10^3; //leangth of Beam ,given in mm
10 Mx=1.65*10^6; //given ,in N.mm
11 Sy=10*10^3; //given ,in N
12 G=27600; //in N/mm^2

```

---

**Scilab code AP 18** Example 23.3 data

```

1 //in order 12,56,26,34,48,83,57,72,61,78
2 L=[1023;1023;1274;2200;250;150;280;180;330;1270]; //
   length
3 t
   =[1.22;1.22;1.63;2.03;2.64;2.64;2.64;2.64;1.63;1.22];
   //thickness
4 A=[265000;213000;413000]; //cell area
5 Gref=27600;
6 G=[27600*ones(9,1);3*27600];
7 B=[2580;3880;3230;3230;3880;2580]; //boom areas
8 y=[165;230;200;-200;-230;-165];
9 Sy=86.8*10^3; //shear load

```

---

**Scilab code AP 19** Example 23.2 data

```

1 //matrices are in the order [120;12 i
   ;13;24;34;35;46;56]
2 L=[1650;508;775;775;380;508;508;254]; //length ,given
   in mm
3 t=[1.22;2.03;1.22;1.22;1.63;0.92;0.92;0.92]; //
   thickness ,given in mm
4 G=[24200;27600;24200;24200;27600;20700;20700;20700];
   //given in N.mm^2
5 Gref=27600; //given in N^mm^2
6 A=[258000;355000;161000]; //cell area ,given in mm^2

```

```
7 T=11.3*10^6; //torque ,given in N.mm
```

---

**Scilab code AP 20** Example 23.1 data

```
1 B=[2580;3880;3230;3230;3880;2580]; //values of boom
   area ,given in mm^2
2 y=[165;230;200;-200;-230;-165]; //values of y,given
   in mm
3 Mx=300*10^6; //given in N.mm
```

---

**Scilab code AP 21** Example 22.2 data

```
1 A=100; //cross sectional area of a stringer
2 r=381; //radius of the fuselage ,given in mm
3 t=0.8; //thickness ,given in mm
4 Sy=100*10^3; //given in N
5 d=150; //distance of action of load from center ,given
   in mm
```

---

**Scilab code AP 22** Example 22.1 data

```
1 A=100; //cross sectional area of a stringer
2 r=381; //radius of the fuselage ,given in mm
3 t=0.8; //thickness ,given in mm
4 Mx=200*10^6;
```

---

**Scilab code AP 23** Example 21.3 data

```
1 Sy=100*10^3; //given in N
2 Aco=900; //area of corner booms,given in mm^2
3 Ace=1200; //area of central booms,given in mm^2
4 t1=2; //thickness ,given in mm
5 tb=3; //thickness ,given in mm
6 L1=1.6*10^3; //leangth of built in end,given in mm
7 L2=0.8*10^3; //leangth of open end,given in mm
8 B1=0.8*10^3; //breadth of built in end,given in mm
9 B2=0.4*10^3; //breadth of open end,given in mm
```



```

10 Lc=2*10^3; //distance of the section from the built
    in end, given in mm
11 L=4*10^3; //leangth of Beam, given in mm

```

---

**Scilab code AP 24** Example 21.2 data

```

1 Sy=100*10^3; //given in N
2 Aco=900; //area of corner booms, given in mm^2
3 Ace=1200; //area of central booms, given in mm^2
4 t1=2; //thickness, given in mm
5 tb=3; //thickness, given in mm
6 L1=1.6*10^3; //leangth of built in end, given in mm
7 L2=0.8*10^3; //leangth of open end, given in mm
8 B1=0.8*10^3; //breadth of built in end, given in mm
9 B2=0.4*10^3; //breadth of open end, given in mm
10 Lc=2*10^3; //distance of the section from the built
    in end, given in mm
11 L=4*10^3; //leangth of Beam, given in mm

```

---

**Scilab code AP 25** Example 21.1 data

```

1 Sy=-20*10^3; //given in N
2 A=400; //given in mm^2
3 t=2; //thickness, given in mm
4 L=2*10^3; //leangth, given in mm
5 L1=1*10^3; //distance of section AA from the end
6 We=200; //width at the end, given in mm
7 W=400; //width at the joint, given in mm

```

---

**Scilab code AP 26** Example 20.4 data

```

1 Sy=10*10^3; //vertical load, given, in N
2 B=[200;250;400;100;100;400;250;200]; //boom area,
    given
3 y=[30;100;100;50;-50;-100;-100;-30]; //x-coordinate
    of each boom
4 x=[120;240;240]; //distences along x-axis between
    booms

```

---

**Scilab code AP 27** Example 20.3 data

```
1 Sy=4.8*10^3; //shear load ,given ,in N
2 A=300; //Boom area ,given ,in mm^2
3 L=200; //leangth ,given ,in mm
```

---

**Scilab code AP 28** Example 20.2 data

```
1 Mx=100*10^6;
2 B=[640;600;600;600;620;640;640;850;640]; //matrix
   having the values of B
3 D=[1200;1140;960;768;565;336;144;38;0]; //matrix
   having the distance of all booms from boom 9
```

---

**Scilab code AP 29** Example 20.1

```
1 L16=400; //given in mm
2 L34=200; //given in mm
3 L12=600; //given in mm
4 L23=600; //given in mm
5 t12=2; //given in mm
6 t23=1.5; //given in mm
7 t34=2; //given in mm
8 t25=2.5; //given in mm
9 t16=3; //given in mm
10 A=300; //given in mm^2
```

---

**Scilab code AP 30** Example 19.2 data

```
1 L12=900; //leangth of section 1-2(outer),given in mm
2 L34=300; //leangth of section 3-4,given in mm
3 L13=600; //leangth of section 1-3,given in mm
4 t13=2; //thickness of section 1-3,given in mm
5 t12=1.5; //thickness of section 1-2,given in mm
6 T=10*10^6; //given in N.mm
7 A=20000; //given in N.mm^2
8 G=25000; //given in N.mm^2
```

---

**Scilab code AP 31** Example 19.1 data

```
1 L12=100; //leangth of 1-2,given in mm
2 L45=200; //leangth of 4-5(3-4-5-6 is a square),given
  in mm
3 t=2; //thickness ,given in mm
4 Sy=100*10^3; //in N
5 G=25000; //given in N/mm^2
```

---

**Scilab code AP 32** Example 18.3 data

```
1 a=25; //leangth along x-axis ,given in mm
2 b=50; //leangth along y-axis ,given in mm
3 tx=2.5; //in mm
4 ty=1.5; //in mm
5 T=10*10^3; //in N.mm
6 G=25000; //given in N/mm^2
```

---

**Scilab code AP 33** Example 18.2 data

```
1 a=200; //in mm
2 b=150; //in mm
3 ta=2.5; //in mm
4 tb=2; //in mm
5 T=1000; //in N.mm
6 G=25000; //given in N/mm^2
```

---

**Scilab code AP 34** Example 18.1 data

```
1 d=200; //given , in mm
2 L=2000; //given ,2m in mm
3 T=30*10^6; //given , in N.mm
4 Tmax=15*10^6; //given
5 Smax=200; //maximum allowable shear stress ,given ,in N
  /mm^2
```

```
6 angle=2*%pi/180; //maximum angle of twist ,given ,in
   degrees
7 G=25000; //given , in N/mm^2
```

---

**Scilab code AP 35** Example 17.3 data

```
1 a=10; //in mm
```

---

**Scilab code AP 36** Example 17.2 data

```
1 h=50; //in mm
2 t=1.5; //in mm
3 b=25; //in mm
```

---

**Scilab code AP 37** Example 17.1 data

```
1 h=100; //in mm
2 t=2; //in mm
3 Sy=200; //in N/mm^2
```

---

**Scilab code AP 38** Example 16.9 data

```
1 W=10; //load in N/m
2 a=5; //L/4, in m
3 EI=70000; //flexural rigidity ,in N.m^2
```

---

**Scilab code AP 39** Example 16.8 data

```
1 W=5; //load in N/m
2 L=20; //leanth in m
3 EI=70000; //flexural rigidity ,in N.m^2
```

---

**Scilab code AP 40** Example 16.7 data

```
1 W=5; //load in N/m
2 L=20; //leanth in m
3 EI=70000; //flexural rigidity ,in N.m^2
```

---

**Scilab code AP 41** Example 16.6 data

```
1 W=5; //load in N/m
2 L=20; //leanth in m
3 EI=70000; //flexural rigidity ,in N.m^2
```

---

**Scilab code AP 42** Example 16.5 data

```
1 W=10; //load in N
2 L=20; //leanth in m
3 EI=70000; //flexural rigidity ,in N.m^2
```

---

**Scilab code AP 43** Example 16.4 data

```
1 a=120; //leangth of cross section along x-axis ,given
   in mm
2 a1=40; //leangth AE
3 b=88; //leangth of cross section along y-axis ,given
   in mm
4 t=8; //thickness ,given in mm
5 Mx=1500*10^3; //given in N.mm
```

---

**Scilab code AP 44** Example 16.3 data

```
1 a=200; //leangth of cross section along x-axis ,given
   in mm
2 b=300; //leangth of cross section along y-axis ,given
   in mm
3 tx=25; //thickness along x-axis ,given in mm
4 ty=20; //thickness along y-axis ,given in mm
5 M=100*10^6; //bending moment ,given in N.mm
6 th=30; //inclination of plane of bending moment ,given
   in degrees
7 theta=th*%pi/180; //th in radians
```

---

**Scilab code AP 45** Example 16.2 data

```
1 a=200; //length of cross section along x-axis ,given
  in mm
2 b=300; //length of cross section along y-axis ,given
  in mm
3 tx=25; //thickness along x-axis ,given in mm
4 ty=20; //thickness along y-axis ,given in mm
5 M=100*10^6; //bending moment ,given in N.mm
```

---

**Scilab code AP 46** Example 16.16 data

```
1 a=100; //in mm
2 t=2; //in mm
3 E=70000; //N/mm^2
4 T0=10; //in K
5 alpha=0.01; //mm/k
```

---

**Scilab code AP 47** Example 16.15 data

```
1 a=100; //in mm
2 t=2; //in mm
3 E=70000; //N/mm^2
4 T0=10; //in K
5 alpha=0.01; //mm/k
```

---

**Scilab code AP 48** Example 16.14 data

```
1 h=100; //in mm
2 t=2; //in mm
3 Mx=1000; //N.mm
```

---

**Scilab code AP 49** Example 16.13 data

```
1 b=100; //in mm
2 tf=2; //in mm
3 tw=2.5; //in mm
4 d=150; //in mm
```

---

**Scilab code AP 50** Example 16.12 data

```
1 Ixx=1.937D+08;  
2 Iyy=27005208;  
3 Ixy=562584521;  
4 E=20000;  
5 L=20;  
6 W=100000
```

---

**Scilab code AP 51** Example 16.11 data

```
1 M0=10; //load in N/m  
2 L=20; //L in m  
3 b=15; //b in m  
4 EI=70000; //flexural rigidity ,in N.m2
```

---

**Scilab code AP 52** Example 16.10 data

```
1 W=10; //load in N/m  
2 L=20; //L in m  
3 EI=70000; //flexural rigidity ,in N.m2
```

---

**Scilab code AP 53** Example 16.1 data

```
1 a=200; //leangth of cross section along x-axis ,given  
   in mm  
2 b=300; //leangth of cross section along y-axis ,given  
   in mm  
3 tx=25; //thickness along x-axis ,given in mm  
4 ty=20; //thickness along y-axis ,given in mm  
5 M=-100*106; //bending moment ,given in N.mm
```

---

**Scilab code AP 54** Example 15.1 data

```
1 K=1708; //fracture toughness , given in N/mm2  
2 S=175; //given in N/mm2  
3 alpha=1; ///given
```

```
4 C=40/10^15; //rete of crack growth, given in mm/cycle
5 n=4; //given
6 ai=0.2; //initial leangth of crack ,given in mm
```

---

**Scilab code AP 55** Example 14.3 dqta

```
1 W=8000; //given in N
2 S=14.5; //wing area ,given in m^2
3 c=1.35; //mean chord ,given in m
4 n=4.5;
5 v=60; //speed ,given in m/s
6 rho=1.223; //air density ,given in kg/m^3
7 alpha1=13.75; //from fig. 14.8(a) ,in degree
8 Cmcg1=0.075; //Cm, cg from fig. 14.8(a)
9 alpha2=13.3; //given in degree
10 Cmcg2=0.073; //given
```

---

**Scilab code AP 56** Example 14.2 data

```
1 W=250; //given in kN
2 Rh=400; //horizontal reaction ,given in kN
3 Rv=1200; //vertical reaction ,given in kN
4 Icg=5.65*10^8; //given in N.s^2
5 Sh=1; //horizontal distence of CG from main wheels ,
   given in m
6 Sv=2.5; //vertical distence of CG from main wheels ,
   given in m
7 v0=3.7; //initial vertical velocity ,given in m/s
8 g=9.81; //in m/s^2;
```

---

**Scilab code AP 57** Example 14.1 data

```
1 W=45; //given in kN
2 Wa=4.5; //wight of aircraft aft ,given in kN
3 v0=25; //given in m/s
4 g=9.81; //in m/s^2;
5 a=3*g; //given
```

---



**Scilab code AP 58** Example 12.2 data

```
1 AD=25; //distance between point A and D, given in mm
2 DC=20; //distance between point D and centroid, given
  in mm
3 DG=25; //distance between point G and D, given in mm
4 CF=25; //distance between point F and centroid, given
  in mm
5 Load=5000; //load, given (5kN in N)
6 CL=75; //distance between the centroid and load
```

---

**Scilab code AP 59** Example 12.1 data

```
1 t=2.5; //skin thickness, given in mm
2 St=1.2; //straps thickness, given in mm
3 d=4; //rivets diameter, given in mm
4 Lt=125; //limit tensile stress
5 Ls=120; //limit shear stress
```

---

**Scilab code AP 60** Example 10.6 data

```
1 m=1; //in Kg
2 EI=70000*2000; //given in N.mm2
3 l=2000; //in mm
```

---

**Scilab code AP 61** Example 10.5 data

```
1 EI=70000*2000; //given in N.mm2
2 L=2000; //in mm
3 rho=1; //in Kg/mm3
4 A=1; //in mm2
```

---

**Scilab code AP 62** Example 10.4 data

```
1 m=1; //in Kg
2 EI=70000*2000; //given in N.mm2
3 L=2000; //in mm
```

```
4 rho=1; //in Kg/mm^3
5 A=1; //in mm^2
```

---

**Scilab code AP 63** Example 10.2 data

```
1 m=1; //in Kg
2 EI=70000*2000; //given in N.mm^2
3 l=2000; //in mm
```

---

**Scilab code AP 64** Example 10.1 data

```
1 m=1; //in Kg
2 EI=70000*2000; //given in N.mm^2
3 l=2000; //in mm
```

---

**Scilab code AP 65** Example 9.1 data

```
1 Af=350; //cross sectional area of flanges ,given in mm
   ^2
2 As=300; //Cross sectional area of stiffners ,given in
   mm^2
3 ESM=750; //elastic section modulus ,given in mm^3
4 t=2; //thickness of web ,given in mm
5 MA=2000; //2nd moment of area of a stiffner ,given in
   mm^4
6 E=70000; //given in N/mm^2
7 I=2000; //moment of inertia
8 d=400; //given in mm
9 b=300; //given in mm
10 W=5000; //given (5 KN in N)
11 z=1200; //given in mm
```

---

**Scilab code AP 66** Example 8.4 data

```
1 L=1000; //given (1m in mm)
2 a2=100; //width of cross section (along x axis) ,given
   in mm
```

```
3 b=100; //leanght of cross section (along y axis), given
   in mm
4 t=2; //thickness
5 E=70000; //given in N/mm^2
6 G=30000; //given in N/mm^2
```

---

**Scilab code AP 67** Example 8.3 data

```
1 L=2000; //given (2m in mm)
2 a=37.5; //width of cross section (along x axis), given
   in mm
3 b=75; //leanght of cross section (along y axis), given
   in mm
4 t=2.5; //thickness
5 E=75000; //given in N/mm^2
6 G=21000; //given in N/mm^2
```

---

**Scilab code AP 68** Example 8.2 data

```
1 L=20; //in mm
2 P=100; //in N
3 e=0.1; //in m
4 E=200000; //in N/^2
5 I=0.5 // moment of Inertia of cross section , in m^4
```

---

**Scilab code AP 69** Example 7.4 data

```
1 a=100; //in mm
2 b=80; //in mm
3 t=2; //in mm
4 E=70000; //in N/mm^2
5 v=0.3;
6 q0=10; //in N/mm^2
```

---

**Scilab code AP 70** Example 7.3 data

```
1 t=2; //in mm
```

```
2 E=70000; //in N/mm^2
3 v=0.3;
4 a=100; //in mm
5 b=100; //in mm
6 q0=10; //in N/mm^2
7 Nx=10; //in n/mm
```

---

**Scilab code AP 71** Example 7.1 data

```
1 t=2; //in mm
2 E=70000; //in N/mm^2
3 v=0.3;
4 a=100; //in mm
5 b=100; //in mm
6 q0=10; //in N/mm^2
```

---

**Scilab code AP 72** Example 6.4 data

```
1 P1=[-2; -1];
2 P2=[2; -1];
3 P3=[2; 1];
4 P4=[-2; 1];
5 u=[0.001; 0.003; -0.003; 0]; //given in m
6 v=[-0.004; -0.002; 0.001; 0.001]; //given in m
7 E=200000; //given in N/mm^2
8 V=0.3; //poission's ratio, given
```

---

**Scilab code AP 73** Example 6.2 data

```
1 L=10; //in m
2 W=1000; //FORCE ON POINT 2
3 M=100; //MOMENT ON POINT 2
4 EI=20000;
```

---

**Scilab code AP 74** Example 6.1 data

```
1 L12=10; //in m
```

```
2 L13=10; //in m
3 AE=200000; //in N
4 FX2=0; //FORCE ON POINT 2 IN X DIRECTION
5 FY2=-10; //-W,FORCE ON POINT 2 IN Y DIRECTION
```

---

**Scilab code AP 75** Example 5.9 data

```
1 L=1; //000; //length , given , in mm
2 P=10; //*10^3; //load , given , in N
```

---

**Scilab code AP 76** Example 5.8 data

```
1 L=1000; //length in mm
2 P=1; //Load in N
```

---

**Scilab code AP 77** Example 5.7 data

```
1 L=2000; //length.in mm
2 EI=2*10^10;
3 GJ=5*10^10;
4 W=0.1; //in N/mm
```

---

**Scilab code AP 78** Example 5.6 data

```
1 r=1000; //in mm
2 M0=1000; //in N.mm
```

---

**Scilab code AP 79** Example 5.5 data

```
1 L=2000; //length.in mm
2 Ab=200; //in mm^2
3 A=180; //area of bar , in mm^2
4 P=1000; //in N
5 theta=60*(%pi/180);
6 E=200000; //in N/mm^2
7 I=100000; //in mm^4
```

---

**Scilab code AP 80** Example 5.4 data

```
1 clear all
2 AB=4000; //length AB, given , in mm
3 BC=3000; //length BC, given , in mm
4 A=200; //area of bar , given , in mm^2
5 delT=30; //change in temprature , given , in celcius;
6 alpha=7/10^6; //coefficient of linear expansion , given
    , in 1/celcius
7 E=200000; //given in N/mm^2
```

---

**Scilab code AP 81** Example 5.3 data

```
1 AC=30; //C.S. area of AC, given , in mm^2
2 A=20; //C.S. areaa of other elements , given , in mm^2
3 L=800; //length , given in mm
4 E=200000; //given in N/mm^2
5 theta=60*(%pi/180);
6 Load=100; //given , in N
```

---

**Scilab code AP 82** Example 5.2 data

```
1 clear all
2 w=5; //in N/m
3 L=20; //in m
4 EI=70000; //in N.m^2
```

---

**Scilab code AP 83** Example 5.12 data

```
1 D=[0; 100; 200; 300; 400; 500; 600; 700; 800];
2 V=[0; -0.3; -1.4; -2.5; -1.9; 0; 2.3; 4.8; 10.6];
3 L0=40;
4 L1=30;
5 L2=10;
```

---

**Scilab code AP 84** Example 5.11 data

```
1 EI=70000; //in N.mm^2
2 W=10; //in N
3 L=20; //in m
```

---

**Scilab code AP 85** Example 5.10 data

```
1 a=4000; //length, given, in mm
2 b=3000; //breadth, given, in mm
3 T=30; //change in temprature, given, in degrees
4 A=200; //given, in mm^2
5 alpha=7/10^6; //given, in 1/C;
6 E=200000; //given, in N/mm^2
```

---

**Scilab code AP 86** Example 5.1 data

```
1 CS=1800; //cross-section area, given in mm^2
2 E=200000; //given in N/mm^2
3 h=4; //height, given in m
4 AB=4; //given in m
5 BC=4; //given in m
6 CD=4; //given in m
7 Load1=40*10^3; //load at point E, given in N
8 Load2=100*10^3; //load at point C, given in N
```

---

**Scilab code AP 87** Example 4.6 data

```
1 CS=1800; //cross-section area, given in mm^2
2 E=200000; //given in N/mm^2
3 h=4; //height, given in m
4 AB=4; //given in m
5 BC=4; //given in m
6 CD=4; //given in m
7 Load1=40*10^3; //load at point E, given in N
8 Load2=100*10^3; //load at point C, given in N
```

---

**Scilab code AP 88** Example 4.5 data

```
1 W=100; //in N
2 L=20; //in m
3 E=200000; //in N/mm^2
4 I=0.5 // moment of Inertia of cross section , in m^4
```

---

**Scilab code AP 89** Example 4.4 data

```
1 w=10; //intensity of distributed load , in N/m
2 L=10; //leangth in m
3 E=200000; //in N/mm^2
4 I=0.5; // moment of Inertia of cross section , in m^4
```

---

**Scilab code AP 90** Example 4.3 data

```
1 CD=4; //given in m
2 BD=3; //given in m
3 Loadc=30; //given in KN
```

---

**Scilab code AP 91** Example 4.2 data

```
1 W=90; //in Newton
2 a=10; //in m
3 L=15; //(a+b) ,in m
```

---

**Scilab code AP 92** Example 4.1 data

```
1 W=100; //in N
2 L=20; //in m
3 a=14; //in m
```

---

**Scilab code AP 93** Example 3.2 data

```
1 a=4; //major axis ,in mm
2 b=3; //minor axis of bar ,in mm
3 T=100000; //applied torque ,in N.mm
4 G=76923; //shear modulus ,in N/mm^2
```

---



**Scilab code AP 94** Example 3.1 data

```
1 R=16; //radius of bar ,in mm
2 T=100000; //applied torque ,in N.mm
3 G=76923; //shear modulus ,in N/mm^2
```

---

**Scilab code AP 95** Example 1.7 data

```
1 d=50; //given (in mm)
2 Ea=1000/10^6;
3 Eb=-200/10^6;
4 Ec=-300/10^6;
5 v=0.3;
6 E=70000; //given (in N/mm^2)
```

---

**Scilab code AP 96** Example 1.5 data

```
1 Sx=60; // x , given (in N/mm^2)
2 Sy=-40; //- y , given (in N/mm^2)
3 Txy=50; // xy , given (in N/mm^2)
4 E=200000; //given (in N/mm^2)
5 v=0.3;
```

---

**Scilab code AP 97** Example 1.4 data

```
1 Sx=83; // x , given (in N/mm^2)
2 Sy=65; // y , given (in N/mm^2)
3 E=200000; // given (in N/mm^2)
4 v=0.3;
```

---

**Scilab code AP 98** Example 1.3 data

```
1 Sx=160; // x , tension stress , given in N/mm^2
2 Sy=-120; // y , compression stress , given in N/mm^2
3 lLoad=200; //limit load , given in N/mm^2
```

---

**Scilab code AP 99** Example 1.2 data

```
1 t=1.5; //given (in mm)
2 d=60; //given (in mm)
3 T=1200*10^3; //in N.mm, given (in N.m)
4 Load=50*10^3; //Compressive load (N)
5 angle= %pi/3; //angle of plane with axis (radian)
6 theta=%pi/2 - angle;
```

---

**Scilab code AP 100** Example 1.1 data

```
1 d=2000; //given (2m in mm)
2 t=20; //given (in mm)
3 p=1.5; //pressure inside the vessel (N/mm^2)
4 Load=2500*10^3; //axial tensile load (N)
5 angle= %pi/3; //angle of plane with axis (radian)
6 theta=%pi/2 -angle;
```

---