# Scilab Textbook Companion for Water and Wastewater Engineering by G. M. Fair, J. C. Geyer and D. A. Okun[1]

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# Book Description

**Title:** Water and Wastewater Engineering

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

**Exa** Example (Solved example)

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

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

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

# Contents

# List of Scilab Codes

# Chapter 2

# Water system

**Scilab code Exa 2.1** Example 1

```
clc
//initialisation of variables
w=3000//sq ft
w1=2000//sq ft
w2=1000//sq ft
r=15//in
a=12//in
h=7.5//in
//CALCULATIONS
G=w*(r/a)*h//gal
g=w1*(r/a)*h//gal
g1=w2*(r/a)*h//gal
//RESULTS
printf('the normally be stored to tide the supply
   over dry spells=% f gal',G)
```

**Scilab code Exa 2.2** Example 2

```
clc
//initialisation of variables
m=17.378//mg
h=20//in/sq mile
d=365//in
s=0.75//percent
a=100//sq miles
p=750000//gpd per sq mile
t=180//in
c=150//gpcd
n=64699 //gpd per sq mile
//CALCULATIONS
R=h*m//mg
A=R/d//mgd
S=s*a*t//billion gal
Q=a*p/c//gpd
P=a*n/c//people against
//RESULTS
printf('the surface water sheds and storage
    requirements=%f mg',R)
printf('the well watered sections of north america=%
    f billion gal',S)
printf('the average consumpition populations=%f gpd
    ',Q)
printf('the presence of proper storage=%f people
    against',P)
```

**Scilab code Exa 2.3** Example 3

```
clc
//initialisation of variables
w=20//ft
r=3//ft a day
g=500//ft
g1=1000//ft
```

```
h=7.5/1440//ft
p=7.5/1000000//ft
r1=2//ft a day
//CALCULATIONS
W1=w*g1*r*h//gpm
W2=w*g1*r1*r*p//mgd
//RESULTS
printf('the ground water laterally =%f gpm',W1)
printf('the water from both sides=%f mgd',W2)
```

**Scilab code Exa 2.4** Example 4

```
clc
//initialisation of variables
p1=10//mgd
p2=6940//gpm
w=67000//people
d=2//min
v=d*p2/d//gal
v1=98.2//cu ft each
q=30//min
q1=q*p2/d//gal
q2=13900//cu ft
a=1390//sq ft
s=2//hr
s1=120*p2/d//gal
s2=55700//cu ft
s3=s2/8//sq ft
r=3//gpm/sq ft
r1=6//rapid
//CALCULATIONS
D=sqrt(v1*4/%pi)//ft
S=p2/s3//gpm/sq ft
A=p2/(r1*r)//sq ft
//RESULTS
```

```
printf('the capacity of the components of a rapid
    sand filtration plant=% f sq ft',A)
```

**Scilab code Exa 2.5** Example 5

```
clc
//initialisation of variables
r=10000//ft
l=400000//people
q=1000000//mgd
w=100//gpcd
w1=150//gpcd
m=50//percent
g=1.5//ft
h1=2.32//cfs
h2=139//cfs
d=12//ft
c=100//ft
l=10.8//ft
l2=0.85//ft
l1=1000//ft
//CALCULATIONS
a=r*w/q//mgd
b=l*w1/q//mgd
a1=a*g//mgd
b1=b*g//mgd
D=d*sqrt(h1/%pi)//in
D1=d*sqrt(h2/%pi)//in
L=l/l1//ft
L1=l2/l1//ft
//RESULTS
printf('the higher loss of head in small conduits at
     equal velocity=% f ft',L1)
```

**Scilab code Exa 2.6** Example 6

```
clc
//initialisation of variables
a=12//in
b=24//in
r=500//gpm
d=200//gpcd
d1=150//gpcd
p1=113//sq in
p2=425//sq in
v1=3//fps
v2=2.35//cfs
v3=9.42//cfs
h=646000//gpd
w=720000//gpd
//CALCULATIONS
D1=v2*h//gpd
D2=v3*h//gpd
W1=D1-w//gpd
W2=D2-w//gpd
R1=D1/d//people
R2=D2/d//people
S=W1/d1//people
S1=W2/d1//people
//RESULTS
printf('the absence of fire service for a maximum
    draft=% f gpd',D2)
printf('The residential fire flow requirements=% f
    gpd',W2)
```

---

**Scilab code Exa 2.7** Example 7

```
clc
//initialisation of variables
w=100000//ft
c=250//per capita
p1=0.3//percent
p2=0.1//percent
p3=0.60//percent
w1=15//mgd
//CALCULATIONS
T=c*w//$
W=p1*T//$
W1=p2*T//$
W2=p3*T//$
W3=((w1)^2/3)*T//$
//RESULTS
printf('the replacement cost of the water of a city=
    %f $',W3)
```

# Chapter 3

# Wastewater systems

**Scilab code Exa 3.1** Example 1

```
clc
//initialisation of variables
v=2.5//fps
c=0.013//gpd
p=300//gpd
d=50//per care
m=5.20//ft
a=1000//ft
//CALCULATIONS
C=[(%pi*64)/(4*144)]*v*646000//gpd
M=m/a//ft
P=C/p
A=P/d//acres
//RESULTS
printf('the acres will it drain if the population
   density=% f acres',A)
```

**Scilab code Exa 3.2** Example 2

```
clc
//initialisation of variables
a=37.4//acres
r=2//in
p=30//min
v=3//fps
r1=0.6//in
h=1.0//cfs
p1=50//percent
q=646000//gpd
//CALCULATIONS
R=r*r1*a//cfs
A=R/v//sq ft
D=12*sqrt(4*A/%pi)//in
P=r*r1*q/p1//gpcd
//RESULTS
printf('the per capita storm runoff for a population
    density=%f gpcd',P)
```

**Scilab code Exa 3.3** Example 3

```
clc
//initialisation of variables
w=1.0//cfs
w1=3.0//cfs
w2=45.0//cfs
v=3.0//fps
h=144//ft
D=12*sqrt(4*w/(%pi*w1))//in
d1=1.95//cfs
D1=12*sqrt(4*d1)/(%pi*v)//in
d2=41.6//cfs
D2=12*sqrt(4*d2)/(%pi*w1)//ins
//CALCULATIONS
C=%pi*(D)^2*3/(4*h)//cfs
```

```
C1=%pi*(1/4)*3//cfs
V=(d2*4)/(%pi*4^2)//fps
//RESULTS
printf('The minimum dry-weather flow =%f cfs',C)
printf('The maximum dry-weather flow in excess actual capacity=%f cfs',C1)
printf('the storm flow in axcess of maximum dry-weather flow=%f fps',V)
```

**Scilab code Exa 3.4** Example 4

```
clc
//initialisation of variables
t=0.8//mgd
d=8000//people
a=2//hr
v=800000//ft
h=10//ft
a1=4//in
d1=1//sq ft per capita
a3=3//mgad
//CALCULATIONS
V=v*(a/24)/a//gal
S=V/h//sq ft
S1=(v/h)/S//gpd per sq ft
V1=a*d/h//cu ft
D=d/S//ft
E=d1*d/a1//sq ft
A=t/a3//acre
//RESULTS
printf('the capacity of the components of a small trickling-filter =%f acre',A)
```

**Scilab code Exa 3.5** Example 5

```
clc
//initialisation of variables
w=2000//sq miles
r=0.1//cfs
d=80000//ft
p=100//gpd
p1=80//ft
p2=340//percent
h=646000//ft
//CALCULATIONS
L=r*w//cfs
R=6*p1/1.4//cfs
P=p1*(p2-L)/p2//percent
D=(d*p)//gpd
D1=(L*h)//gpd
//RESULTS
printf('the percent of removal of pollutional load
    needed=% f percent',P)
```

**Scilab code Exa 3.6** Example 6

```
clc
//initialisation of variables
p=10000//people
p1=4//ft
w=10//in
s=80//gpcd
h=43560//ft
p2=20//ft
//CALCULATIONS
R=[(w/12)*7.5*h]/365//gpad
A=p*s/R//acres
A1=1.7//sq miles
```

```
P=p/500//acres
D=p2*h*4*7.48/(p*s)//days
//RESULTS
printf('the detention period in ponds =%f days',D)
```

**Scilab code Exa 3.7** Example 7

```
clc
//initialisation of variables
p=100000//people
a=75//$
a2=47//in
b=10//in
//CALCULATIONS
P=a*p//people
S=((a)*(b^5))/(b)^1/4//$
//RESULTS
printf('the money is inversed in the sanitary
   sewerage system=%f $',S)
```

# Chapter 4

# Information analysis

**Scilab code Exa 4.1** Example 1

```
clc
//initialisation of variables
y=19.5//in
x=396.8//in
n=6//in
y1=2.20//in
x1=51.14//in
p=5.64//in
//CALCULATIONS
Beta=(x-n*(y)*(y1))/(x1-n*(y1)^2)
X=p+Beta//minimum
//RESULTS
printf('the method of leate squares =% f minimum',X)
```

**Scilab code Exa 4.3** Example 2

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

```
a=12//in
h=121//in
p=11//in
s=220//in
//CALCULATIONS
B={a/[p*(h-1)]}*s//per unit
//RESULTS
printf('the interval of time a noted before=%f per
    unit',B)
```

**Scilab code Exa 4.5** Example 3

```
clc
//initialisation of variables
a=4404//ft
q=9//ft
mu=12//ft
//CALCULATIONS
F=sqrt(a/q)//ft
CF=F/mu*100//percent
//RESULTS
printf('the coefficient of fluctuation is =%f
    percent',CF)
```

**Scilab code Exa 4.7** Example 4

```
clc
//initialisation of variables
h2=5//in
x=3.72//in
x1=1.28//in
//CALCULATIONS
H=h2*x1/x//in
```

```
//RESULTS
printf('the either side of the center of the scale=%
    f in',H)
```

**Scilab code Exa 4.8** Example 5

```
clc
//initialisation of variables
p=80//in
q=20//in
//CALCULATIONS
K=p+q//ft
//RESULTS
printf('the moments of the arithmetically normal
    frequency curve=% f ft',K)
```

**Scilab code Exa 4.9** Example 6

```
clc
//initialisation of variables
g=3.2541//in
g1=3.46//in
m=0.5390//ft
h=2/99//ft
p=1.52//ft
//CALCULATIONS
L=sqrt(g*h)//in
mu=g1*p//in
M=g1/p//percent
//RESULTS
printf('the points necessary to plot the straigt
    line of fit on log probability=% f percent',M)
```

# Chapter 5

# Water and wastewater volume

**Scilab code Exa 5.1** Example 1

```
clc
//initialisation of variables
t1=5.25//yr
t2=10.00//yr
yi=171000//in
ye=111000//in
yt=5.23300//in
yl=5.04532//in
yn=31500//in
ym=0.09853//in
tm=9.25//yr
tn=10.00//yr
//CALCULATIONS
T=t1/t2//yr
T1=tm/tn//yr
Y=yi-ye//in
Yt=yt-yl//in
//RESULTS
printf('the fifth intercensal year =% f yr',T)
printf('the ninth postcensal year =% f yr',T1)
```

**Scilab code Exa 5.2** Example 2

```
clc
//initialisation of variables
y0=30000//in
y1=172000//in
y2=292000//in
a=172//ft
p=30//ft
y=292//ft
q=322000//ft
g=313//ft
n=0.05//ft
d=-2.442//ft
//CALCULATIONS
L=[2*p*a*y2-(a)^2*q]/[p*y-(a)^2]//moreover
m=(g-p)/p//ft
N=n*d//in
Y=g/[1+m*(N)]//in
//RESULTS
printf('the saturation populations=% f moreover',L)
printf('the coefficients=% f in',N)
printf('the equation of a logistic curve=% f in',Y)
```

**Scilab code Exa 5.4** Example 3

```
clc
//initialisation of variables
p=100000//in
d=150//in
h=1000000//in
a1=2.0//draft
```

```
a2=3.0//draft
a3=1.6//draft
m=1.5//in
q=2.5//in
v=1020//in
w=100//in
t=0.01//in
v1=13.2//mgd
//CALCULATIONS
A=d*p/h//mgd
M=m*A//mgd
M1=q*A//mgd
V=v*sqrt(w)*(1-t*sqrt(w))//gpm
D=M+v1//mgd
L=a1*A//mgd
L1=(4/3)*M//max
H=a2*A//mgd
H1=(4/3)*M1//max
F=a3*A//mgd
F1=(4/3)*M//max
//RESULTS
printf('the resulting capacities of the four system
    =% f max',F1)
```

**Scilab code Exa 5.6** Example 4

```
clc
//initialisation of variables
r=48//in
A=450//gpd/acre
B=8000//gpd/mile
S=5280/350//manholes/mile
//CALCULATIONS
C=(B-S*100)/12//gpd/mile
//RESULTS
```

```
printf('the ground a quarter of it eventually =%f
   gpd/mile',C)
```

**Scilab code Exa 5.7** Example 5

```
clc
//initialisation of variables
p1=20//ft
p2=30//ft
w=5//person
s=17800//in
h=1200//in
q=100//in
i=1//in
//CALCULATIONS
S=p1*p2*i*s/(h*w)//gpcd
P=(q*p1*p2/S)//percent
//RESULTS
printf('the degree of separation of stormwater=%f
   percent',P)
```

**Scilab code Exa 5.8** Example 6

```
clc
//initialisation of variables
s=105//gpcd
m=315//gpcd
m1=35//gpcd
Q1=360//gpcd
Q2=30//gpcd
p1=20//pecent
p2=15//persons/acer
D=21//persons/acre
```

```
I=2000//gpd/acre
//CALCULATIONS
A=D*(s+Q2)+I//gpd/acre
R=D*(m+Q2)+I//gpd/acre
L=D*(m1+Q2)+I//gpd/acre
//RESULTS
printf('the average peak and low rates of flow =% f
    gpd/acre',L)
```

# Chapter 6

# Elements of hydrology

**Scilab code Exa 6.1** Example 1

```
clc
//initialisation of variables
H=1360//ft
t=60//f
a=(10^3)*5.5*(10^-3)//f
q=(1.36*10^3)*5.5*(10^-3)//f
s=(4-1.36)*(10^3)*(3.2*10^-3)//f
//CALCULATIONS
T=t-q-s//F
T1=T+3*a//F
//RESULTS
printf('the temperature at the mountain top=% f F',T
    )
printf('the temperature on the plain beyond the
    mountain=% f F',T1)
```

**Scilab code Exa 6.2** Example 2

```
clc
//initialisation of variables
t=60//f
v=0.52//in
t1=80//F
p=40//percent
v1=1.03*0.40//in
w=8//mph
pa=29.0//in
p1=0.497//ft
q=1.32*10^-2//ft
r=0.268//ft
//CALCULATIONS
E=p1*(1-q*pa)*(1+r*w)*(v-v1)//in
//RESULTS
printf('the evaporation for the a day during=% f in'
    ,E)
```

---

**Scilab code Exa 6.3** Example 3

```
clc
//initialisation of variables
t=47//f
q=8000//ft
a=100//ft
d=0.10//in
d1=7//degree days
s1=14000//ft
s2=7000//ft
s=1000//ft
g=32//ft
h=17.37//ft
h1=1.547//ft
//CALCULATIONS
T=q+s*(t-g)/3//ft
```

```
T1=t-3*1//F
T2=(T1+g)/2//F
T3=d1*d*a//sq mile in
M=h*T3//mgd
M1=M*h1//cfs
//RESULTS
printf('the upper boundary of the melting zone and
    temperature at the snow line=% f F',T1)
printf('The average temperature of =% f cfs',M1)
```

# Chapter 7

# Rainfall and runoff

**Scilab code Exa 7.5** Example 1

```
clc
//initialisation of variables
n=20//ft
s=sqrt(12676/19)//ft
c=45.5//ft
q=551400//ft
q1=12700//ft
h=8.5//ft
w=s/c//ft
//CALCULATIONS
D=q/(2*s*q1)//cfs
D1=D*(1+h/n)//cfs
//RESULTS
printf('the record runoff of a stream draining=% f
   cfs',D1)
```

**Scilab code Exa 7.6** Example 2

```
clc
//initialisation of variables
i=16/(62)^0.66//in hr
q=(16*10^0.31)/(62)^0.66//in hr
c=1.0//max
C1=c*(0.01)^0.31//in
C2=c*(0.1)^0.31//in
x1=640//cfs
//CALCULATIONS
Y1=C1*i*c*x1//cfs
Y2=C2*q*c*x1//cfs
//RESULTS
printf('the time of concentration=%f cfs',Y2)
```

**Scilab code Exa 7.8** Example 3

```
clc
//initialisation of variables
d=163*48.5//cfs
a=48.5//ft
q=100//cfs
Q=45.5*a//cfs
c=0.57//cfs
v=1.8//cfs
p=0.45//ft
//CALCULATIONS
P=d/(q*sqrt(a))//percent
C=Q/(a^0.8*(1+2*a^-0.3))//cfs
d1=2.6//cfs
T=(1-p*c+v*c*2)//cfs
//RESULTS
printf('the meyers rating =%f percent',P)
printf('the magnitude of the maximum peak flood =%f
    cfs',T)
```

# Chapter 8

# Storage and runoff control

**Scilab code Exa 8.2** Example 1

```
clc
//initialisation of variables
a=0.75//ft
p=123//mg
v=100//ft
s=33//mg
s1=67//mg
d=26.6//mgd
d1=0.0477//mgd
q=0.750//gpd/sq mile
d2=365//days
//CALCULATIONS
S=p/a//mg per sq mile
Cv=v*s/s1//percent
M=d*d1//mgd per sq mile
D=v*q/M//MAF
D1=(v*p)/(M*d2)//MAF
R=p/q//days
//RESULTS
printf('the use monthly averages rather then daily
   stream flow=% f days',R)
```

**Scilab code Exa 8.3** Example 2

```
clc
//initialisation of variables
d=750000//gpd per sq mile
v=0.22//ft
a=1.27//ft
q=0.30//ft
d1=365//days
p=0.25//ft
//CALCULATIONS
Q=q*a*d1//mg/sq mile
H=p*a*d1//mg/sq mile
//RESULTS
printf('the results obtained by normal analytical
   procedures and by Hazen s=% f mg/sq mile',H)
```

**Scilab code Exa 8.4** Example 3

```
clc
//initialisation of variables
d=30.0//mgd
a=40.0//sq miles
a1=1500//acres
r1=47.0//in
r2=27.0//in
q=0.9//in
k=640//in
h=0.052//gpd/sq mile
//CALCULATIONS
Q=r2-(r2+a-r1)*q*a1/(k*a)//in
```

```
D=d+a*h//mgd
A=a-(q*a1/k)*[1-(r1-a)/(r2)]//sq miles
R=r2+a-r1//in
S=R*q//in
//RESULTS
printf('the revised mean annual runoff=% f in',Q)
printf('the equivalent mean draft=% f mgd',D)
printf('the equivalent land area=% f sq miles',A)
printf('the adjusted flowline=% f in',S)
```

**Scilab code Exa 8.6** Example 4

```
clc
//initialisation of variables
p=100//ft
q=27000//acre-ft
p1=10//ft
s=8250//acre-ft
//CALCULATIONS
R=p*s/q//percent
//RESULTS
printf('the ratio of peak inflow from fuller values=
   % f percent',R)
```

# Chapter 9

# Groundwater flow

**Scilab code Exa 9.1** Example 1

```
clc
//initialisation of variables
t=10//C
s=74.2//days
c=0.01//mm
d=245//mm
//CALCULATIONS
h=s/(d*c)//cm
//RESULTS
printf('the high will water at a temperature =% f cm
    ',h)
```

---

**Scilab code Exa 9.2** Example 2

```
clc
//initialisation of variables
p1=1000//ft
p2=50//ft
```

```
g=20//ft/mile
v=5280//ft
q=7.5*10^-6//ft
t=60//F
k=2835//ft/days
p=7.5//ft
//CALCULATIONS
S=g/v//ft
W=k*(g/v)//ft/day
Q=W*p1*p2*q//mgd
P=k*p//ft
P1=P*p2//mgd
//RESULTS
printf('the velocity of flow =% f mgd',Q)
printf('the standard coefficient pf permeability=% f
    mgd',P1)
```

**Scilab code Exa 9.3** Example 3

```
clc
//initialisation of variables
p=40//ft
d=56//ft
d1=140//ft
p1=30//ft
w=3.28*10^-4//fps
//CALCULATIONS
Q=w*(p/d1)*2*d*p//cfs
q=Q/p//cfs
K=w*(p/d1)//fps
x0=q/(2*%pi*K)//ft
Z=2*%pi*x0//ft
//RESULTS
printf('the yield of the well if the coefficient of
   permeability=% f ft',x0)
```

```
printf('the distance of the point of stagnation =% f
    ft',Z)
```

**Scilab code Exa 9.4** Example 4

```
clc
//initialisation of variables
p=5*10^6//ft
Q=350//gpm
x=225//ft
u=10^-2//ft
g=1.87//ft
p2=7*10^2//ft
p3=10.9//ft
w=4.0//ft
t=114.6//ft
d=10//ft
p1=5//ft
w1=3.2*10^4//ft
W=21.75//ft
//CALCULATIONS
T=t*Q*4/p1//gpd/ft
S=u*(w1)/[g*(p)]//ft
U=g*[(S)/(T)]*(x^2/d)//ft
P=t*(p2)*p3/(T)//ft
U1=g*[(S)/(T)]*(1/d)//ft
P1=t*(p2)*W/(T)//ft
//RESULTS
printf('the type curve as if a transparency of the
   observed data had moved into place over the type=
   % f ft',P1)
```

**Scilab code Exa 9.5** Example 5

```
clc
//initialisation of variables
Q=350//gpm
x=225//ft
t=1//min
p=1.6//ft
t2=10//min
p2=4.5//ft
p3=700//gpm
T=3.2*10^4//gpd/ft
t0=0.3//min
u=1.15*10^-5
//CALCULATIONS
S=t0*(T)*t0/[(x)^2*1440]//ft
P=[(114.6*p3)/(T)]*(-0.5772*2.3*log(u))//ft
//RESULTS
printf('A straight line being drawn through the
    ppints for the higher=% f ft',P)
```

**Scilab code Exa 9.6** Example 6

```
clc
//initialisation of variables
h=4.8//ft
m=13.4//ft
k=10^-1//cm/sec
k1=3.28*10^-3//fps
n=7//ft
n1=11//ft
q=1.0*10^-2
//CALCULATIONS
Q=k1*h*n/n1//cfs/ft
Q1=2*q*10^2//cfs
//RESULTS
printf('A satisfactory orthogonal system the flow of
```

```
into the collector =% f cfs',Q1)
```

# Chapter 10

# Groundwater collection

**Scilab code Exa 10.1** Example 1

```
clc
//initialisation of variables
w1=1000//ft
w2=2000//ft
r=700//gpm
d=10//days
q=2//ft
u=1.87*[(3.4*10^-5)/(3.2*10^4)]*(d^6/d)//ft
W=7.94//ft
p=114.6*(7*10^2)*W/(3.2*10^4)//ft
U=1.87*[(3.4*10^-5)/(3.2*10^4)]*(4*d^6/d)//ft
Wu=6.55//ft
P=114.6*(7*10^2)*Wu/(3.2*10^4)//ft
R=54//ft
//CALCULATIONS
W1=R+p+P//ft
D=R+q*p//ft
//RESULTS
printf('the expected drawndown the first well is
   pumped at a rate=% f ft',W1)
printf('the drawdown in each well all the three are
```

```
pupped at a rate=%f ft',D)
```

**Scilab code Exa 10.3** Example 2

```
clc
//initialisation of variables
g=20//ft
k=10^-1//cm/sec
g1=3.28*10^-3//fps
w=2//ft
w1=30//ft
//CALCULATIONS
Q=(1/2)*(g1)*[(g^2)-(2^2)]/(w1)//cfs
//RESULTS
printf('the flow into a foot of gallery=%f cfs',Q)
```

# Chapter 11

# Surface water collections

**Scilab code Exa 11.1** Example 1

```
clc
//initialisation of variables
s=20//mph
t=90//min
w=1.31//ft
h=7.5//miles
h1=0.22//ft
t1=1100//min
t2=6.0//min
p=32.2//ft
l=5.12//length
l1=2.8//length
p1=1400//ft
d=73//depth
h3=2.06//ft
e=173.0//ft
hi=0.2//ft
//CALCULATIONS
W=s*w//mph
hs=h1*[(W)^2/p]^0.53*h^0.47//ft
Ts=t2*(W/p)^0.44*(h/p)^0.28//sec
```

```
Td=t1*h/(p*Ts)//min
Ls=l1/(l*(Ts)^2)//ft
D=d/(l*(Ts)^2)//ft
H=(W)^2*[h*(1/(p1*d))]//ft
hr=h3*l1//ft
M=e+hi+hr//ft
//RESULTS
printf('the overwater wind speed=%f mph',W)
printf('the significant wave height=%f ft',hs)
printf('the significant wave period=%f sec',Ts)
printf('the minimum wind duration required to reach the significant wave height=%f min',Td)
printf('the significant wave lenght adn steepness=%f ft',Ls)
printf('the reservoir depth ratio=%f ft',D)
printf('the wind tide or set up=%f ft',H)
printf('the run up =%f ft',hr)
printf('the maximum elevation reached by the waves=%f ft',M)
```

**Scilab code Exa 11.2** Example 2

```
clc
//initialisation of variables
g=264//quartz
p=0.39//percent
//CALCULATIONS
S=(1-p)*(g-1)//in
//RESULTS
printf('the hydralic gradient and seepage velocity=%f in',S)
```

**Scilab code Exa 11.3** Example 3

```
clc
//initialisation of variables
w=40//ft
k=2*10^-3//cm/sec
p=3.28*10^-3//cfs
h=6.47*10^5//gpd
p1=0.433//ft
m=9//ft
delh=w/(18*9)//in
k1=4.94*10^-4//cm/sec
//CALCULATIONS
Q=k*p*w*(9/18)//cfs
Q1=Q*h//gpd/ft width
P=(1-8/18)*w*p1//Psig
H=k1/k//in
//RESULTS
printf('the seepage through each foot width of the
    foundation=%f gpd/ft/ width',Q1)
printf('the excess hydrostatic pressure on the
    upstream  side of the bottom of the sheet pilling
    =%f Psig',P)
printf('the maximum hydraulic gradient and its
    relations to the coeeficent=%f in',H)
```

**Scilab code Exa 11.4** Example 4

```
clc
//initialisation of variables
d=120//ft
w=16//ft
d1=120/0.8//ft
p=60*0.8//ft
h=2//ft
v=18.74*0.8//ft
s=95.23//ft
```

```
s1=0.8//ft
//CALCULATIONS
W=d-h*p//ft
S=s*s1//ft
//RESULTS
printf('in succession from the intersection of the
   upstream slop=% f ft',S)
```

# Chapter 12

# Water transmission

**Scilab code Exa 12.1** Example 1

```
clc
//initialisation of variables
c=100//in
a=10//in
Q=0.976//ft
//CALCULATIONS
G=a*Q//ft
//RESULTS
printf('the graphical basic =% f ft',G)
```

**Scilab code Exa 12.2** Example 2

```
clc
//initialisation of variables
a=27.6//sq ft
h=1.37//ft
d=1.53*(27.9)^0.38*(1.36)^0.24//ft
//CALCULATIONS
```

```
R=d/4//ft
A=(%pi*d^2)/4//sq ft
//RESULTS
printf('The diameter hydraulics radius and area of
    the hydraulically equivalent circular conduit=% f
     sq ft',A)
```

**Scilab code Exa 12.3** Example 3

```
clc
//initialisation of variables
h1=13.5//ft
h2=19.0//ft
h3=27.5//ft
c1=2.0*10^4//ft
c2=2.1*10^4//ft
c3=2.2*10^4//ft
//CALCULATIONS
H=h1+h2+h3//ft
C=c1+c2+c3//ft
//RESULTS
printf('the most economical distributions of the
    available head=% f ft',C)
```

**Scilab code Exa 12.4** Example 4

```
clc
//initialisation of variables
p=60//in
h=20//percent
a=1000//ft
h1=40//percent
c=0.5//ft
```

```
p1=14.3//ft
p2=6.1//ft
d=11.7*10^-2//ft
//CALCULATIONS
P=p2/p1//ft
D=d*p//ft
//RESULTS
printf('the air valve with a discharge the change in
    slop=% f ft ',D)
```

**Scilab code Exa 12.5** Example 5

```
clc
//initialisation of variables
p=90//deg
h=48//in
p1=100//psig
P=(1/2*%pi)*h^2*p1*0.7071//lb
r=3000/54-31//ft
s=9000//psi
l=170//in
b=6.5*10^-6//ft
w=46//ft
w1=1000//ft
//CALCULATIONS
D=(1/4*%pi)*h^2*p1//lb
P=[r]*h^2//lb
T=%pi*h*(1/4)*s//lb
T1=(1/2)*l//tons
Del=b*w*w1//ft per
//RESULTS
printf('the accorance with unless otherwise stated=%
    f ft per',Del)
```

# Chapter 13

# Water distribution

**Scilab code Exa 13.2** Example 1

```
clc
//initialisation of variables
p1=7.8//ft
p2=6.0//ft
p3=7.4//ft
p4=6.5//ft
p=7.6//ft
h=1.0//ft
h1=6.7//ft
p5=3.3//ft
//CALCULATIONS
D=p1-p2//mgd
D1=p1-p3//mgd
D2=p-p4//mgd
D3=p4+h//mgd
D4=h1-p5//mgd
//RESULTS
printf('the demand is taken =% f mgd',D3)
```

**Scilab code Exa 13.3** Example 2

```
clc
//initialisation of variables
w=500//ft
p=20//psig
h=40//psig
h1=1000//in
q=1250//ft
g=2.308/0.75//ft
g1=2.308/1.00//ft
s=5200//gpm
a=250//gpm
//CALCULATIONS
H=[h1-(1/2)*(w)]//ft
H1=(h-p)*g//percent
Q=[q-(1/2)*(w)]//ft
Q1=(h-p)*g1//percent
S=s/a//gpm
//RESULTS
printf('the number of standard fire streams=% f gpm'
    ,S)
```

---

**Scilab code Exa 13.6** Example 3

```
clc
//initialisation of variables
h1=2.1*3//ft
h2=2.1//ft
h=8.4//ft
p=1000//ft
h3=5.7//ft
h4=4.2*3//ft
q=4.2//ft
s=1.68//ft
```

```
q1=1.33//ft
//CALCULATIONS
A=p*h/h2//ft
B=p*(h3+h4)/q//ft
C=p*(h1+h2)/s//ft
//RESULTS
printf('the equilent pipe for the Hazen willians coefficent=%f ft',A)
printf('the equilent pipe for the Hazen willians coefficent=%f ft',B)
printf('the equilent pipe for the Hazen willians coefficent=%f ft',C)
```

**Scilab code Exa 13.8** Example 4

```
clc
//initialisation of variables
d=10//hr
p=50000//in
a=7.5//mgd
w=0.75//mg
s=5.03//mg
//CALCULATIONS
S=s/w//mg
P=S-s//mg
//RESULTS
printf('a steady gravity supply equal to maximum daily=%f mg',P)
```

# Chapter 14

# Wastewater flows

**Scilab code Exa 14.1** Example 1

```
clc
//initialisation of variables
n=0.013//ft
s=4.90//ft
v=0.590//ft
d=0.463//ft
w=3.9*10^-2//ft
p=1.696//ft
//CALCULATIONS
V=s*v//fps
Q=s*d//cfs
N=(w*p)^2*1000//percent
//RESULTS
printf('the velocity of flow and rate of discharge=%
    f percent',N)
```

**Scilab code Exa 14.2** Example 2

```
clc
//initialisation of variables
v=1.34//fps
s=3.7*10^-3//fps
k=0.8//ft
r=20//ft
k1=0.04//ft
v=3.0//fps
v1=5.0//fps
d=10^-1//ft
d1=1.34//ft
//CALCULATIONS
K=r*k1//ft
V=sqrt(r)//times
D=d*(v/d1)^2//cm
D1=d*(v1/d1)^2//cm
//RESULTS
printf('the minimum velocity and the gradient at the
    which coarse quartz=% f cm',D1)
```

**Scilab code Exa 14.3** Example 3

```


clc
//initialisation of variables
v=2.5//fps
q=0.873//cfs
s=5.20//percent
a=0.252//ft
r=0.684//ft
r1=1.46//ft
v1=0.776//ft
q1=0.196//ft
n=0.78//ft
```

```
R=0.939//ft
//CALCULATIONS
V=v1*v//fps
Q=q1*q//cfs
R1=r1*s//percent
Vs=R*v//ft
N=n*Vs//fps
Qs=a*R*q//cfs
N1=n*Qs//cfs
//RESULTS
printf('the required grades and associated velocity
   and rates=%f cfs',V)
printf('the depth and a grade=%f cfs',Q)
printf('the self cleaning flow=%f cfs',N1)
```

**Scilab code Exa 14.4** Example 4

```
clc
//initialisation of variables
Q=0.873//cfs
s=5.20//percent
d=0.161//cfs
q1=0.185//ft
d2=2.5//ft
v=0.91//ft
s1=1.70//ft
s3=1.46//ft
w=0.185//ft
d1=0.30//ft
v1=0.732//ft
//CALCULATIONS
q=d/Q//cfs
Vs=v*d2//fps
Ss=s1*s//percent
Va=v1*d2//fps
```

```
Ss1=s3*s//percent
//RESULTS
printf('the depth and velocity of flow and the
   required slop=% f percent',Ss1)
```

---

**Scilab code Exa 14.5** Example 5

```
clc
//initialisation of variables
d1=0.67//ft
h1=2.00//ft
h2=4.04//ft
hv1=0.062//ft
hv2=0.254//ft
d=0.19//ft
h=0.2//ft
h1=0.04//ft
q=0.644//ft
q1=0.65//ft
v=0.92//ft
d2=6.5//ft
v1=3.69//ft
d3=0.542//ft
hv3=0.21//ft
delv=0.15//ft
d4=0.02//ft
//CALCULATIONS
H=d1+hv1//ft
H1=d1+hv2//ft
he=h*d//ft
hi=d+h1//ft
H2=d3+hv3//ft
he1=h*delv//ft
S=d4+h1//ft
//RESULTS
```

```
printf('the required slope=% f ft',hi)
printf('the lower sewer and the invert drop in the
    transition=% f ft',S)
```

**Scilab code Exa 14.6** Example 6

```
clc
//initialisation of variables
q=60//cfs
D=4//ft
w=0.177//ft
s=0.59//ft
h=4.0//ft
d1=1.0//ft
v=0.90//ft
d1=0.42//ft
h1=6.0//ft
h2=1.5//ft
dl=1.3//ft
p=0.41//ft
u=0.8//ft
u1=3.2//ft
y=0.45//ft
//CALCULATIONS
H=s*D//ft
d2=d1*D//ft
V=v*D//ft
P=p*D//ft
D1=y*D//ft
//RESULTS
printf('the critical depth=% f ft',H)
printf('the alternate stages for an energy =% f ft',
    V)
printf('the alternate stages for an energy head=% f
    ft',P)
```

```
printf('the lower alternate stage with upper
    alternate stage=%f ft',D1)
```

**Scilab code Exa 14.7** Example 7

```
clc
//initialisation of variables
d=106//cfs
q=400//cfs
d1=0.40//cfs
w=10//ft
//CALCULATIONS
D=d/q//cfs
D1=d1*w//cfs
//RESULTS
printf('the water level in this well rises=%f cfs',
    D1)
```

**Scilab code Exa 14.8** Example 8

```
clc
//initialisation of variables
Q=8.07*10^-2//ft
N=0.012//ft
d=0.47//ft
q=10//ft
//CALCULATIONS
D=d*q//ft
//RESULTS
printf('teh water surface in the sewer when it is
    flowing at maximum capacity=%f ft',D)
```

**Scilab code Exa 14.9** Example 9

```
clc
//initialisation of variable
g=sqrt(3)//ft
d=5.67//ft
//CALCULATIONS
C=g*d//ft
//RESULTS
printf('The rate of propagation of a discontinuous
    surge=%f ft',C)
```

---

**Scilab code Exa 14.10** Example 10

```
clc
//initialisation of variables
Q1=30//cfs
Q2=16//cfs
a=32//sq ft
r=1.6//ft
i=10^-4//ft
n=1.25*10^-2//ft
h2=0.50//ft
c=3.33//ft
h1=5.20//ft
l=72//ft
s=12320//ft
//CALCULATIONS
L=s-l//ft
//RESULTS
printf('the forchheimer s methos =%f ft',L)
```

---

**Scilab code Exa 14.11** Example 11

```
clc
//initialisation of variables
q=1.0//cfs
g=2.0//percent
g1=5.6//percent
r=0.015//cfs
w=90//percent
Q=10*0.9*q//ft
p=0.10//ft
h=(3.48*g1^1/3)//ft
d=p^2/3*100//ft
//CALCULATIONS
D=h*d//in
//RESULTS
printf('The maximum depth of flow in the gutter=%f
   in',D)
```

# Chapter 15

# Wastewater collection

**Scilab code Exa 15.1** Example 1

```
clc
//initialisation of variables
q=0.25//in
Q=0.34//in
r=0.76//in
v=0.83//in
n=0.78//in
r1=0.84//in
v1=0.70//in
w=2//in
q1=0.056//in
d=0.16//in
v2=0.53//in
n1=0.80//in
d1=0.18//in
n2=0.46//in
//CALCULATIONS
V=v*w//fps
N=v1*w//fps
V1=v2*w//fps
V2=n2*w//fps
```

```
//RESULTS
printf('The one fourth their full flow=% f fps',N)
printf('The one enghteenth their full flow=% f fps',
   V2)
```

**Scilab code Exa 15.2** Example 2

```
clc
//initialisation of variables
v=2.5//fps
N=0.015//fps
a=(40+27)//in
b=(40*27+27*19)/a
c=0.440//cfs
w=49*0.09/100//cfs
g=0.008//percent
Q=0.82//cfs
r=0.795//cfs
t=2.35*1.16//fps
d1=113.20-113.03//ft
d2=12//ft
//CALCULATIONS
R=r/Q//cfs
D=g*r//in
D2=d1*d2//in
//RESULTS
printf('The required capacity and find the slope
   size and hydraulic characteristics of the system=
   % f in',D2)
```

**Scilab code Exa 15.3** Example 3

```
clc
```

```
//initialisation of variables
p=20//min
N=0.012//in
k=2.19//min
l=k+1.97//min
q=340/(60*3.94)//min
r=2.56*0.508//min
del=0.42//min
j=84.28//min
w1=0.92//min
//CALCULATIONS
r1=r*k//cfs
w=p+q//min
G=j-del//min
S=(G-w1)//min
//RESULTS
printf('The required capacity and find the slop size and hydraulic=% f min',S)
```

**Scilab code Exa 15.4** Example 4

```
clc
//initialisation of variables
a=42//in
d=45//mgd
d1=0.75//in
s=60//ft
p1=9//in
p2=8.4//in
p3=9//in
c1=13*63.6//sq in
c2=9*55.4//sq in
c3=9.21//sq ft
M=d*1.547//cfs
v=M/c3//fps
```

```
g=0.025*32.2//ft/sec^2
//CALCULATIONS
F=v/sqrt(g*(p1/12))//ft
S=s/d1//in
//RESULTS
printf('the port near the end of the diffuser pipe=%
    f in',F)
```

# Chapter 16

# Machinery and equipment

**Scilab code Exa 16.2** Example 1

```
clc
//initialisation of variables
p=500//ft
p1=6//in
t=500//cfm
p2=7//psig
P=p2+14.7//psia
T=520*(P/14.7)^0.283//F
f=0.048*p1^0.027/(t)^0.148//in
//CALCULATIONS
delP=20*10^-3*p*T*(t)^2/(38*10^3*P*p1^5)//psia
//RESULTS
printf('the pressure drop=%f psia',delP)
```