

# SHAPE AND DIMENSIONS FOR THE MOST ECONOMIC OPEN CHANNELS BY USING THE APPLICATION OF COMPUTER SCIENCE

<sup>1</sup> Yogabalaji G, <sup>2</sup> Akalya R S

<sup>1</sup> Department of Civil Engineering

<sup>2</sup> Department of Computer Science Engineering

<sup>1,2</sup> PSG Institute of Technology and Applied Research, Coimbatore, India.

[yogabalajig@gmail.com](mailto:yogabalajig@gmail.com)

[akalyashammu@gmail.com](mailto:akalyashammu@gmail.com)

**Abstract:** In hydraulics, open channel flow is defined as the flow of liquid in a free surface exposed to the atmosphere through any passage. It has various applications in the civil engineering field as well as day-to-day life. For example, flow in waterfall, river, and stream. This paper presents the shape and dimensions of the most economic open channel for a given discharge and velocity of flow. By using the application of computer science such as python and C programming, the shape and dimensions for the most economic open channel can be found .

**Keywords:** Design of open channels, Most economic channels, Open channels in hydraulics

## 1.INTRODUCTION:

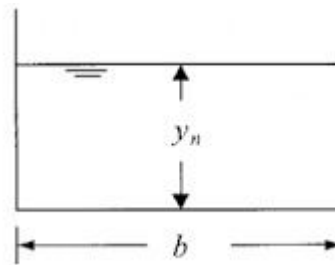
In an open channel flow, flow is not due to any pressure. It is due to the slope of the bed of the channel. Open channels may be either natural channels such as rivers and streams having irregular cross-sections of flow or artificial channels which have fairly well-maintained shapes and cross-sections. This paper gives an idea of the shape and dimensions of the most economic open channel. The most economical cross-section of a channel is one that gives the maximum discharge with a constant cross-section. From the Continuity equation, It is clear that the discharge is maximum, the wetted perimeter is minimum. By introducing some conditions, the most economic channel can be found through the application of computer science such as python and C programming.

## 2.PROPERTIES OF OPEN CHANNEL FLOW:

- (1)Open channel flow takes place by gravity force.
- (2)The hydraulic grade line coincides with the water surface.
- (3)The shape of the velocity profile is dependent on the channel roughness.
- (4)The maximum velocity occurs at a little distance below the water surface.
- (5)Flow cross-section depends on the depth of flow.

## 3.TYPES OF OPEN CHANNEL FLOW:

### 3.1.RECTANGULAR CHANNEL:



**y** - The vertical distance between the base of the channel and free surface

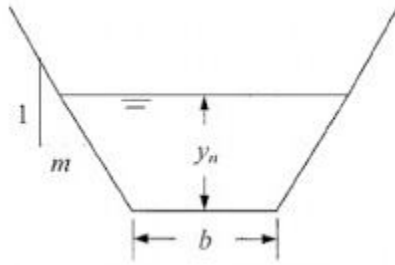
**b** - The surface width of the channel

**S** - Bed Slope

**V** - Velocity of flow

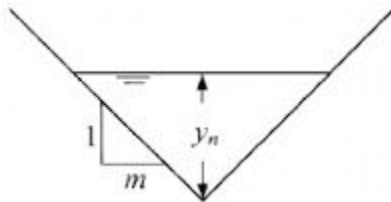
**Q** - Discharge of flow

### 3.2. TRAPEZOIDAL CHANNEL:



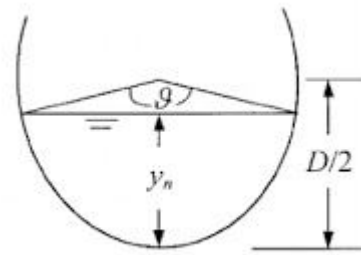
- y** - The vertical distance between the base of the channel and free surface
- T** - Top width of the channel
- b** - The surface width of the channel
- S** - Bed Slope
- V** - Velocity of flow
- Q** - Discharge of flow
- m** - Side Slope

### 3.3. TRIANGULAR CHANNEL:



- y** - The vertical distance between the base of the channel and free surface
- b** - The surface width of the channel
- S** - Bed Slope
- V** - Velocity of flow
- Q** - Discharge of Flow
- Theta** - Angle between two inclined lines

### 3.4. SEMICIRCULAR CHANNEL:



- y** - The vertical distance between the base of the channel and free surface
- r** - The radius of the channel
- S** - Bed Slope
- V** - Velocity of flow
- Q** - Discharge of flow
- Theta** - Angle subtended by water surface

## 4. CONDITIONS FOR THE MOST ECONOMIC CHANNEL:

### 4.1. RECTANGULAR CHANNEL:

- (1) Depth of the channel is equal to the width of the channel
- (2) Hydraulic radius is equal to half the depth

### 4.2. TRAPEZOIDAL CHANNEL:

- (1) Sloping side of the cross-section is equal to the half of the top width
- (2) Hydraulic radius is equal to half of the depth of water

### 4.3. TRIANGULAR CHANNEL:

- (1) The angle between the two inclined sides is  $90^\circ$

### 4.4. SEMICIRCULAR CHANNEL:

- (a) The angle subtended by water surface is equal to  $154^\circ$
- (b) Depth of channel is equal to 0.9 times of the radius

## 5.DESIGN OF THE MOST ECONOMICAL RECTANGULAR CHANNEL:

### 5.1.C PROGRAMMING:

```
#include<stdio.h>
#include<math.h>
double Vr,Qr,Cr,yr,br,Rr,Sr,Pr,Ar;
double rect(void)
{
    //inputs:V,Q,C
    //outputs:y,b,R,S;
    printf("\t\t\tRECTANGULAR CHANNEL\n");
    printf("\tENTER THE RATE OF DISCHARGE V : ");
    scanf("%Lf",&Vr);
    printf("\tENTER THE VELOCITY OF DISCHARGE Q : ");
    scanf("%Lf",&Qr);
    printf("\tENTER THE VALUE OF CHEZY'S CONSTANT C : ");
    scanf("%Lf",&Cr);
    Ar = Qr/Vr;
    yr=(sqrt((0.5*Qr)/Vr));
    br=2*yr;
    Rr=yr/2;
    Sr=(pow(Vr,2)/(pow(Cr,2) * Rr));
    Sr=1/Sr;
    Pr = (Ar/yr)+(2*yr);
    return Pr;
}
void refficient()
{
    printf("\t\t\tOUTPUT - PARAMETERS\n");
    printf("\tWETTED PERIMETER OF THE CHANNEL P = %Lf\n",Pr);
    printf("\tVERTICAL HEIGHT OF THE FLOW y = %Lf\n",yr);
    printf("\tWIDTH OF THE CHANNEL b = %Lf\n",br);
    printf("\tBED SLOPE S = 1:%Lf\n",Sr);
}
int main()
{
    rect();
    refficient();
    return 0;
}
```

#### Sample Cases:

RECTANGULAR CHANNEL

#### (input)

ENTER THE RATE OF DISCHARGE V : 6  
ENTER THE VELOCITY OF DISCHARGE Q : 8

ENTER THE VALUE OF CHEZY'S CONSTANT C : 62

OUTPUT PARAMETERS

#### (output)

WETTED PERIMETER OF THE CHANNEL P = 3.265986

VERTICAL HEIGHT OF THE FLOW y = 0.816497

WIDTH OF THE CHANNEL b = 1.632993

BED SLOPE S = 1:43.591845

### 5.2.PYTHON PROGRAMMING:

```
import math
def rect():
    print("\n\t\t\tRECTANGULAR CHANNEL\n")
    V=float(input("ENTER THE VALUE OF VELOCITY V : "))
    Q=float(input("ENTER THE RATE OF DISCHARGE Q : "))
    C=float(input("ENTER THE VALUE OF CHEZY'S CONSTANT C : "))
    A = Q/V
    rect.y = math.sqrt((0.5*Q)/V)
    rect.b = 2 * rect.y
    rect.R = rect.y/2
    rect.S = (pow(V,2)/(pow(C,2) * rect.R))
    rect.S = 1/rect.S
    rect.P = (A/rect.y) + (2 * rect.y)
    refficient()

def refficient():
    print("THE EFFICIENT RECTANGULAR WITH PARAMETERS : \n")
    print("WETTED PERIMETER OF THE CHANNEL P = ",rect.P)
    print("VERTICAL HEIGHT OF THE FLOW y = ",rect.y)
    print("WIDTH OF THE CHANNEL b = ",rect.b)
    print("BED SLOPE S = 1:",rect.S)

rect()
```

#### Sample Cases:

RECTANGULAR CHANNEL

#### (input)

ENTER THE VALUE OF VELOCITY V : 6  
ENTER THE RATE OF DISCHARGE Q : 8  
ENTER THE VALUE OF CHEZY'S CONSTANT C : 62

#### (output)

THE EFFICIENT RECTANGULAR CHANNEL WITH PARAMETERS :

WETTED PERIMETER OF THE CHANNEL P =  
3.265986323710904  
VERTICAL HEIGHT OF THE FLOW y =  
0.816496580927726  
WIDTH OF THE CHANNEL b = 1.632993161855452  
BED SLOPE S = 1: 43.591845237308036

## 6.DESIGN OF THE MOST ECONOMICAL TRAPEZOIDAL CHANNEL:

### 6.1.C PROGRAMMING:

```
#include<stdio.h>
#include<math.h>
double Vz,Qz,Cz,mz,yz,bz,Sz,Az,Rz,Pz,Tz;
double trap(void)
{
//inputs:V,Q,C,M
//outputs:y,b,S
printf("\t\t\tTRAPEZOIDAL CHANNEL\n");
printf("\tENTER THE RATE OF DISCHARGE V : ");
scanf("%Lf",&Vz);
printf("\tENTER THE VELOCITY OF DISCHARGE
Q : ");
scanf("%Lf",&Qz);
printf("\tENTER THE VALUE OF CHEZY'S
CONSTANT C : ");
scanf("%Lf",&Cz);
printf("\tENTER THE VALUE OF SIDE SLOPE m :
");
scanf("%Lf",&mz);
Az = (Qz/Vz);
bz = 2*(sqrt(pow(mz,2)+1)-mz);
yz = sqrt(Az/((2*sqrt(pow(mz,2)+1))-mz));
bz = bz*yz;
Rz = yz/2;
Sz = (pow(Vz,2)/(pow(Cz,2) * Rz));
Sz = 1/Sz;
Tz = bz + (2*mz*yz);
Pz = bz +(2*yz*sqrt(pow(mz,2)+1));
return Pz;
}
void trefficient()
{
printf("\t\t\tOUTPUT - PARAMETERS\n");
printf("\tWETTED PERIMETER OF THE CHANNEL
P = %Lf\n",Pz);
printf("\tVERTICAL HEIGHT OF THE FLOW y =
%Lf\n",yz);
printf("\tWIDTH OF THE CHANNEL b = %Lf\n",bz);
printf("\tBED SLOPE S = 1:%Lf\n",Sz);
```

```
printf("\tTOP WIDTH OF THE CHANNEL T =
%Lf\n",Tz);
}
```

```
int main()
{
trap();
trefficient();
return 0;
}
```

### Sample Cases:

TRAPEZOIDAL CHANNEL

### (input)

ENTER THE RATE OF DISCHARGE V : 10  
ENTER THE VELOCITY OF DISCHARGE Q : 12  
ENTER THE VALUE OF CHEZY'S CONSTANT C :  
60  
ENTER THE VALUE OF SIDE SLOPE m : 1.5  
OUTPUT PARAMETERS

### (output)

WETTED PERIMETER OF THE CHANNEL P =  
3.179095  
VERTICAL HEIGHT OF THE FLOW y = 0.754932  
WIDTH OF THE CHANNEL b = 0.457150  
BED SLOPE S = 1:13.588772  
TOP WIDTH OF THE CHANNEL T = 2.721945

### 6.2.PYTHON PROGRAMMING:

```
import math
def trap():
print("\n\t\t\tTRAPEZOIDAL CHANNEL\n")
V = float(input("ENTER THE VALUE OF
VELOCITY V : "))
Q = float(input("ENTER THE RATE OF
DISCHARGE Q : "))
C = float(input("ENTER THE VALUE OF CHEZY'S
CONSTANT C : "))
m = float(input("ENTER THE VALUE OF SIDE
SLOPE m : "))
A = (Q/V)
trap.b = 2 * (math.sqrt(pow(m,2)+1)-m)
trap.y = math.sqrt(A/((2 * math.sqrt(pow(m,2)+1))-
m))
trap.b = trap.b * trap.y
R = trap.y / 2
trap.S = (pow(V,2)/(pow(C,2) * R))
trap.S = 1 / trap.S
trap.T = trap.b + (2 * m * trap.y)
trap.P = trap.b +(2 * trap.y * math.sqrt(pow(m,2)+1))
trefficient()
```



VERTICAL HEIGHT OF THE FLOW  $y = 1.224745$   
 TOP WIDTH OF THE CHANNEL  $T = 2.449490$   
 BED SLOPE  $S = 1:15.564058$   
 THETA IN TRI-ANGLE BETWEEN TWO INCLINED SLIDES  $\Theta = 90.000000$

**7.2.PYTHON PROGRAMMING:**

```
import math
def tri():
    print("\n\t\t\t\t\tTRIANGULAR CHANNEL\n")
    V = float(input("ENTER THE VALUE OF VELOCITY V : "))
    Q = float(input("ENTER THE RATE OF DISCHARGE Q : "))
    C = float(input("ENTER THE VALUE OF CHEZY'S CONSTANT C : "))
    tri.Theta = float(90)
    A = (Q/V)
    tri.y = math.sqrt(A)
    tri.P = 2.83 * tri.y
    R = 0.353 * tri.y
    tri.S = (pow(V,2)/(pow(C,2) * R))
    tri.S = 1/tri.S
    tri.T = 2 * tri.y
    tefficient()
```

```
def tefficient():
    print("THE EFFICIENT SHAPE IS TRIANGLE WITH PARAMETERS : \n")
    print("WETTED PERIMETER P = ",tri.P)
    print("VERTICAL HEIGHT OF FLOW y = ",tri.y)
    print("TOP WIDTH OF THE CHANNEL T = ",tri.T)
    print("THETA IN TRI-ANGLE BETWEEN TWO INCLINED SLIDES Theta = ",tri.Theta)
    print("BED SLOPE S = 1:",tri.S)
```

tri()

**Sample Cases:**

TRIANGULAR CHANNEL

**(input)**

ENTER THE VALUE OF VELOCITY V : 10  
 ENTER THE RATE OF DISCHARGE Q : 15  
 ENTER THE VALUE OF CHEZY'S CONSTANT C : 60

**(output)**

THE EFFICIENT SHAPE IS TRIANGLE WITH PARAMETERS :  
 WETTED PERIMETER  $P = 3.466027986038197$   
 VERTICAL HEIGHT OF FLOW  $y = 1.224744871391589$   
 TOP WIDTH OF THE CHANNEL  $T = 2.449489742783178$   
 THETA IN TRI-ANGLE BETWEEN TWO INCLINED SLIDES  $\Theta = 90.0$   
 BED SLOPE  $S = 1: 15.564057825644312$

**8.DESIGN OF THE MOST ECONOMICAL SEMICIRCULAR CHANNEL:**

**8.1.C PROGRAMMING:**

```
#include<stdio.h>
#include<math.h>
double Qs,Vs,ys,Ss,As,Ps,rs,Ts,Rs,Cs,degs=154;
double semi(void)
{
    //inputs : Q,V,T
    //outputs : r,y,s
    printf("\t\t\t\t\tSEMICIRCULAR CHANNEL\n");
    printf("\tENTER THE RATE OF DISCHARGE V : ");
    scanf("%Lf",&Vs);
    printf("\tENTER THE VELOCITY OF DISCHARGE Q : ");
    scanf("%Lf",&Qs);
    printf("\tENTER THE VALUE OF CHEZY'S CONSTANT C : ");
    scanf("%Lf",&Cs);
    Ts = 0.0175 * degs;
    As = (Qs/Vs);
    rs = sqrt(As/(Ts-(sin(2*degs)/2)));
    ys = rs * 0.9;
    Ps = rs * Ts;
    Rs = (As/Ps);
    Ss=(pow(Vs,2)/(pow(Cs,2) * Rs));
    Ss=1/Ss;
    return Ps;
}
void cefficient()
{
    printf("\t\t\t\t\tOUTPUT - PARAMETERS\n");
    printf("\tWETTED PERIMETER OF THE CHANNEL P = %Lf\n",Ps);
    printf("\tVERTICAL HEIGHT OF THE FLOW y = %Lf\n",ys);
    printf("\tRADIUS OF THE CHANNEL r = %Lf\n",rs);
    printf("\tBED SLOPE S = 1:%Lf\n",Ss);
```

```
printf("\tTHETA IN SEMICIRCULAR-ANGLE
SUBTENDED BY WATER SURFACE Theta =
%Lf\n",degs);
}
int main()
{
    semi();
    cefficient();
    return 0;
}
```

**Sample Cases:**

SEMICIRCULAR CHANNEL

**(input)**

ENTER THE RATE OF DISCHARGE V : 8  
 ENTER THE VELOCITY OF DISCHARGE Q : 14  
 ENTER THE VALUE OF CHEZY's CONSTANT C :  
 60  
 OUTPUT PARAMETERS

**(output)**

WETTED PERIMETER OF THE CHANNEL P =  
 2.197030  
 VERTICAL HEIGHT OF THE FLOW y = 0.733702  
 RADIUS OF THE CHANNEL r = 0.815225  
 BED SLOPE S = 1:44.804804  
 THETA IN SEMICIRCULAR-ANGLE SUBTENDED  
 BY WATER SURFACE Theta = 154.000000

**8.2.PYTHON PROGRAMMING:**

```
import math
def semi():
    deg=float(154)
    print("\n\t\t\t\tSEMICIRCULAR CHANNEL\n")
    V = float(input("ENTER THE VALUE OF
VELOCITY V : "))
    Q = float(input("ENTER THE RATE OF
DISCHARGE Q : "))
    C = float(input("ENTER THE VALUE OF CHEZY'S
CONSTANT C : "))
    T = 0.0175 * deg
    A = (Q/V)
    semi.r = math.sqrt(A/(T-(math.sin(2 * deg)/2)))
    semi.y = 0.9 * semi.r
    semi.P = semi.r * T
    R = A/semi.P
    semi.S = pow(V,2)/(pow(C,2) * R)
    semi.S = 1/semi.S
    cefficient()
```

```
def cefficient():
    print("THE EFFICIENT SHAPE IS SEMICIRCLE
WITH PARAMETERS : \n")
    print("WETTED PERIMETER OF THE CHANNEL P
= ",semi.P)
    print("VERTICAL HEIGHT OF FLOW y = ",semi.y)
    print("RADIUS OF THE CHANNEL r = ",semi.r)
    print("BED SLOPE S = 1:",semi.S)

semi()
```

**Sample Cases:**

SEMICIRCULAR CHANNEL

**(input)**

ENTER THE VALUE OF VELOCITY V : 8  
 ENTER THE RATE OF DISCHARGE Q : 14  
 ENTER THE VALUE OF CHEZY's CONSTANT C :  
 60

**(output)**

THE EFFICIENT SHAPE IS SEMICIRCLE WITH  
 PARAMETERS :  
 WETTED PERIMETER OF THE CHANNEL P =  
 2.197030043879308  
 VERTICAL HEIGHT OF FLOW y =  
 0.7337020554698986  
 RADIUS OF THE CHANNEL r =  
 0.8152245060776652  
 BED SLOPE S = 1: 44.80480377327402

**9.SHAPE AND DESIGN OF THE MOST ECONOMICAL CHANNEL:**

Usually, In the design of open channels, dimensions of the most Economic channel for particular shapes can be found. But this programming is going to give the shape and respective dimensions for the most economical channel.

**9.1.C PROGRAMMING:**

```
rect.c
#include<stdio.h>
#include<math.h>
double Vr,Qr,Cr,yr,br,Rr,Sr,Pr,Ar;
double rect(void)
{
    //inputs:V,Q,C
```

```

//outputs:y,b,R,S;
printf("\t\t\tRECTANGULAR
CHANNEL\n");
printf("\tENTER THE RATE OF DISCHARGE V : ");
scanf("%Lf",&Vr);
printf("\tENTER THE VELOCITY OF DISCHARGE
Q : ");
scanf("%Lf",&Qr);
printf("\tENTER THE VALUE OF CHEZY'S
CONSTANT C : ");
scanf("%Lf",&Cr);
Ar = Qr/Vr;
yr=(sqrt((0.5*Qr)/Vr));
br=2*yr;
Rr=yr/2;
Sr=(pow(Vr,2)/(pow(Cr,2) * Rr));
Sr=1/Sr;
Pr = (Ar/yr)+(2*yr);
return Pr;
}
void refficient()
{
printf("\t\t\t\t\tTHE MOST ECONOMICAL
CHANNEL IS SEMICIRCULAR CHANNEL WITH
THE PARAMETERS :\n");
printf("\tWETTED PERIMETER OF THE CHANNEL
P = %Lf\n",Pr);
printf("\tVERTICAL HEIGHT OF THE FLOW y =
%Lf\n",yr);
printf("\tWIDTH OF THE CHANNEL b = %Lf\n",br);
printf("\tBED SLOPE S = 1:%Lf\n",Sr);
}

```

#### **trapezoid.c**

```

#include<stdio.h>
#include<math.h>
double Vz,Qz,Cz,mz,yz,bz,Sz,Az,Rz,Pz,Tz;
double trap(void)
{
//inputs:V,Q,C,M
//outputs:y,b,S
printf("\t\t\t\tTRAPEZOIDAL CHANNEL\n");
printf("\tENTER THE RATE OF
DISCHARGE V : ");
scanf("%Lf",&Vz);
printf("\tENTER THE VELOCITY OF DISCHARGE
Q : ");
scanf("%Lf",&Qz);
printf("\tENTER THE VALUE OF CHEZY'S
CONSTANT C : ");
scanf("%Lf",&Cz);
printf("\tENTER THE VALUE OF SIDE SLOPE m :
");
scanf("%Lf",&mz);
Az = (Qz/Vz);
bz = 2*(sqrt(pow(mz,2)+1)-mz);

```

```

yz = sqrt(Az/((2*sqrt(pow(mz,2)+1))-mz));
bz = bz*yz;
Rz = yz/2;
Sz = (pow(Vz,2)/(pow(Cz,2) * Rz));
Sz = 1/Sz;
Tz = bz + (2*mz*yz);
Pz = bz +(2*yz*sqrt(pow(mz,2)+1));
return Pz;
}
void trefficient()
{
printf("\t\t\t\t\t\t\t\t\tTHE MOST ECONOMICAL
CHANNEL IS SEMICIRCULAR CHANNEL WITH
THE PARAMETERS :\n");
printf("\tWETTED PERIMETER OF THE CHANNEL
P = %Lf\n",Pz);
printf("\tVERTICAL HEIGHT OF THE
FLOW y = %Lf\n",yz);
printf("\tWIDTH OF THE CHANNEL b = %Lf\n",bz);
printf("\tBED SLOPE S = 1:%Lf\n",Sz);
printf("\tTOP WIDTH OF THE CHANNEL T =
%Lf\n",Tz);
}

```

#### **triangle.c**

```

#include<stdio.h>
#include<math.h>
//inputs : Q,V,C
//outputs : T,y,s
double Qt,Vt,Ct,yt,St,At,Pt,Rt,Thetat=90,Tt;
double tri(void)
{
printf("\t\t\t\t\t\t\tTRIANGULAR CHANNEL\n");
printf("\tENTER THE RATE OF DISCHARGE V : ");
scanf("%Lf",&Vt);
printf("\tENTER THE VELOCITY OF DISCHARGE
Q : ");
scanf("%Lf",&Qt);
printf("\tENTER THE VALUE OF CHEZY'S
CONSTANT C : ");
scanf("%Lf",&Ct);
At = (Qt/Vt);
yt = sqrt(At);
Pt = 2.83 * yt;
Rt = 0.353 * yt;
St = (pow(Vt,2)/(pow(Ct,2) * Rt));
St = 1/St;
Tt = 2*yt;
return Pt;
}
void tefficient()
{
printf("\t\t\t\t\t\t\t\t\tTHE MOST ECONOMICAL
CHANNEL IS SEMICIRCULAR CHANNEL WITH
THE PARAMETERS :\n");

```



```
printf("\tWETTED PERIMETER OF THE CHANNEL
P = %Lf\n",Pt);
printf("\tVERTICAL HEIGHT OF THE FLOW y =
%Lf\n",yt);
printf("\tTOP WIDTH OF THE CHANNEL T =
%Lf\n",Tt);
printf("\tBED SLOPE S = 1:%Lf\n",St);
printf("\tTHETA IN TRI-ANGLE BETWEEN TWO
INCLINED SLIDES Theta = %Lf\n",Thetat);
}
```

**semicircle.c**

```
#include<stdio.h>
#include<math.h>
double Qs,Vs,ys,Ss,As,Ps,rs,Ts,Rs,Cs,degs=154;
double semi(void)
{
    //inputs : Q,V,T
    //outputs : r,y,s
printf("\t\t\t\tSEMICIRCULAR CHANNEL\n");
printf("\tENTER THE RATE OF DISCHARGE V : ");
scanf("%Lf",&Vs);
printf("\tENTER THE VELOCITY OF DISCHARGE
Q : ");
scanf("%Lf",&Qs);
printf("\tENTER THE VALUE OF CHEZY'S
CONSTANT C : ");
scanf("%Lf",&Cs);
Ts = 0.0175 * degs;
As = (Qs/Vs);
rs = sqrt(As/(Ts-(sin(2*degs)/2)));
ys = rs * 0.9;
Ps = rs * Ts;
Rs = (As/Ps);
Ss=(pow(Vs,2)/(pow(Cs,2) * Rs));
Ss=1/Ss;
return Ps;
}
void cefficient()
{
printf("\t\t\t\t\t\t\t\tTHE MOST ECONOMICAL
CHANNEL IS SEMICIRCULAR CHANNEL WITH
THE PARAMETERS :\n");
printf("\tWETTED PERIMETER OF THE CHANNEL
P = %Lf\n",Ps);
printf("\tVERTICAL HEIGHT OF THE FLOW y =
%Lf\n",ys);
printf("\tRADIUS OF THE CHANNEL r = %Lf\n",rs);
printf("\tBED SLOPE S = 1:%Lf\n",Ss);
printf("\tTHETA IN SEMICIRCULAR-ANGLE
SUBTENDED BY WATER SURFACE Theta =
%Lf\n",degs);
}
```

**efficient.c**

```
#include<stdio.h>
#include "rect.c"
#include "triangle.c"
#include "trapezoid.c"
#include "semicircle.c"
int main(void)
{
    int i,j,min;
    double P[4];
    P[0] = rect();
    P[1] = trap();
    P[2] = semi();
    P[3] = tri();
    min = P[0];
    for(i=0;i<4;i++)
    {
        if(min>=P[i])
        {
            min = P[i];
            j=i;
        }
    }
    switch(j)
    {
        case 0:refficient();
            break;
        case 1: trefficient();
            break;
        case 2: cefficient();
            break;
        case 3: tefficient();
            break;
    }
}
```

**Sample Cases:**

**(input)**

```
RECTANGULAR CHANNEL
ENTER THE RATE OF DISCHARGE V : 5
ENTER THE VELOCITY OF DISCHARGE Q : 10
ENTER THE VALUE OF CHEZY'S CONSTANT C :
60
TRAPEZOIDAL CHANNEL
ENTER THE RATE OF DISCHARGE V : 5
ENTER THE VELOCITY OF DISCHARGE Q : 10
ENTER THE VALUE OF CHEZY'S CONSTANT C :
60
ENTER THE VALUE OF SIDE SLOPE m : 1.5
SEMICIRCULAR CHANNEL
```

```

ENTER THE RATE OF DISCHARGE V : 5
ENTER THE VELOCITY OF DISCHARGE Q : 10
ENTER THE VALUE OF CHEZY's CONSTANT C :
60
TRIANGULAR CHANNEL
ENTER THE RATE OF DISCHARGE V : 5
ENTER THE VELOCITY OF DISCHARGE Q : 10
ENTER THE VALUE OF CHEZY's CONSTANT C :
60
    
```

**(output)**

```

THE MOST ECONOMICAL CHANNEL IS
SEMICIRCULAR CHANNEL WITH THE
PARAMETERS :
WETTED PERIMETER OF THE CHANNEL P =
2.348724
VERTICAL HEIGHT OF THE FLOW y = 0.784360
RADIUS OF THE CHANNEL r = 0.871512
BED SLOPE S = 1:122.619776
THETA IN SEMICIRCULAR-ANGLE SUBTENDED
BY WATER SURFACE Theta = 154.000000
    
```

**9.2.PYTHON PROGRAMMING:**

**rect.py**

```

import math
def rect():
print("\n\t\t\t\tRECTANGULAR CHANNEL\n")
V=float(input("ENTER THE VALUE OF
VELOCITY V : "))
Q=float(input("ENTER THE RATE OF
DISCHARGE Q : "))
C=float(input("ENTER THE VALUE OF CHEZY's
CONSTANT C : "))
A = Q/V
rect.y = math.sqrt((0.5*Q)/V)
rect.b = 2 * rect.y
rect.R = rect.y/2
rect.S = (pow(V,2)/(pow(C,2) * rect.R))
rect.S = 1/rect.S
rect.P = (A/rect.y) + (2 * rect.y)
return rect.P
    
```

```

def refficient():
print("THE EFFICIENT SHAPE IS RECTANGLE
WITH PARAMETERS : \n")
print("P = ",rect.P)
print("y = ",rect.y)
print("b = ",rect.b)
print("R = ",rect.R)
print("S = 1:",rect.S)
    
```

**trapezoid.py**

```

import math
def trap():
print("\n\t\t\t\tTRAPEZOIDAL CHANNEL\n")
V = float(input("ENTER THE VALUE OF
VELOCITY V : "))
Q = float(input("ENTER THE RATE OF
DISCHARGE Q : "))
C = float(input("ENTER THE VALUE OF CHEZY's
CONSTANT C : "))
m = float(input("ENTER THE VALUE OF SIDE
SLOPE m : "))
A = (Q/V)
trap.b = 2 * (math.sqrt(pow(m,2)+1)-m)
trap.y = math.sqrt(A/((2 * math.sqrt(pow(m,2)+1))-
m))
trap.b = trap.b * trap.y
R = trap.y / 2
trap.S = (pow(V,2)/(pow(C,2) * R))
trap.S = 1 / trap.S
trap.T = trap.b + (2 * m * trap.y)
trap.P = trap.b +(2 * trap.y * math.sqrt(pow(m,2)+1))
return trap.P
    
```

```

def trefficient():
print("THE EFFICIENT SHAPE IS TRAPEZOID
WITH PARAMETERS : \n")
print("P = ",trap.P)
print("T = ",trap.T)
print("y = ",trap.y)
print("b = ",trap.b)
print("s = 1:",trap.S)
    
```

**triangle.py**

```

import math
def tri():
print("\n\t\t\t\tTRIANGULAR CHANNEL\n")
V = float(input("ENTER THE VALUE OF
VELOCITY V : "))
Q = float(input("ENTER THE RATE OF
DISCHARGE Q : "))
C = float(input("ENTER THE VALUE OF CHEZY's
CONSTANT C : "))
tri.Theta = float(90)
A = (Q/V)
tri.y = math.sqrt(A)
tri.P = 2.83 * tri.y
R = 0.353 * tri.y
tri.S = (pow(V,2)/(pow(C,2) * R))
tri.S = 1/tri.S
tri.T = 2 * tri.y
return tri.P
    
```

```

def tefficient():
print("THE EFFICIENT SHAPE IS TRIANGLE
WITH PARAMETERS : \n")
    
```

```

print("P = ",tri.P)
print("y = ",tri.y)
print("T = ",tri.T)
print("Theta = ",tri.Theta)
print("S = 1:",tri.S)
semicircle.py
import math
def semi():
    deg=float(154)
    print("\n\t\t\t\tSEMICIRCULAR CHANNEL\n")
    V = float(input("ENTER THE VALUE OF VELOCITY V : "))
    Q = float(input("ENTER THE RATE OF DISCHARGE Q : "))
    C = float(input("ENTER THE VALUE OF CHEZY'S CONSTANT C : "))
    T = 0.0175 * deg
    A = (Q/V)
    semi.r = math.sqrt(A/(T-(math.sin(2 * deg)/2)))
    semi.y = 0.9 * semi.r
    semi.P = semi.r * T
    R = A/semi.P
    semi.S = pow(V,2)/(pow(C,2) * R)
    semi.S = 1/semi.S
    return semi.P
def cefficient():
    print("THE EFFICIENT SHAPE IS SEMICIRCLE WITH PARAMETERS : \n")
    print("P = ",semi.P)
    print("y = ",semi.y)
    print("r = ",semi.r)
    print("S = 1:",semi.S)

```

```

efficient.py
import rect
import trapezoid
import semicircle
import triangle
P = [rect.rect(), trapezoid.trap(), semicircle.semi(), triangle.tri()]
x = P.index(min(P))
if(x==0):
    rect.refficient()
elif(x==1):
    trapezoid.trefficient()
elif(x==2):
    semicircle.cefficient()
else:
    triangle.tefficient()

```

**Sample Cases:**

**(input)**  
RECTANGULAR CHANNEL

ENTER THE VALUE OF VELOCITY V : 5  
ENTER THE RATE OF DISCHARGE Q : 10  
ENTER THE VALUE OF CHEZY'S CONSTANT C : 60

TRAPEZOIDAL CHANNEL

ENTER THE VALUE OF VELOCITY V : 5  
ENTER THE RATE OF DISCHARGE Q : 10  
ENTER THE VALUE OF CHEZY'S CONSTANT C : 60  
ENTER THE VALUE OF SIDE SLOPE m : 1.5

SEMICIRCULAR CHANNEL

ENTER THE VALUE OF VELOCITY V : 5  
ENTER THE RATE OF DISCHARGE Q : 10  
ENTER THE VALUE OF CHEZY'S CONSTANT C : 60

TRIANGULAR CHANNEL

ENTER THE VALUE OF VELOCITY V : 5  
ENTER THE RATE OF DISCHARGE Q : 10  
ENTER THE VALUE OF CHEZY'S CONSTANT C : 60

**(output)**

THE EFFICIENT SHAPE IS SEMICIRCLE WITH PARAMETERS :  
P = 2.348723912184368  
y = 0.7843604901543344  
r = 0.8715116557270383  
S = 1: 122.61977600089797

**10.CONCLUSION:**

These computer applications give dimensions for the most economical open channels for different shapes. It saves time as well as complex calculations. It also gives an idea about which shape should be the most economical one. Results showing that a semicircular section is the best economical channel but due to difficulty in creating it, a trapezoidal section can be considered to be the most efficient. Considering the programming languages, python is better than C programming in speed, usage, declaration of variables, error debugging, complexity, memory management and in many other metrics.

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