

Matlab Modelling of Various Open Channel Flow Parameters

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Abstract:- Open channel flow is the definition of liquid flowing through a channel having a free surface. The liquid's free surface is under the influence of air pressure. Irrigation ditches, streams, waterworks operations, storm water and sanitary sewer systems, and industrial to municipal monitoring stations are a few examples. It is more crucial to efficiently and properly measure open channel flows in order to reduce the total margin of error. An old method for determining the water flow rates in streams, irrigation channels, and storm water systems is open channel flow monitoring. The technique is also applied in wastewater treatment to track the release of effluent. Weirs and flumes have been used in the majority of open channel flow applications. Open channel flow calculations are more complicated than pipe flow calculations because the location of the free-surface is often unknown beforehand. The calculation involved are much more complex and time consuming. There is also a risk of manual error while performing these calculations. So these paper aims at providing a programming model of most of the Open Channel Flow parameters. The formulas and theories used are common in practice and the results obtained are far more precise than that obtained from manual calculations.

I. INTRODUCTION

The flow of liquid through a channel with a free surface is defined as open channel flow. This free surface of the liquid is subjected to atmospheric pressure. The flow in an open channel takes place due to gravity that is achieved by providing a bed slope.

Examples include irrigation ditches, streams, water works processes, sanitary and storm water sewage systems, and industrial to municipal metering stations. The open channel flows are measured effectively and efficiently – minimizing the overall margin of error.

Open channel flow monitoring is an old technique for measuring water flow rates in irrigation channels, streams, and storm water systems. The method is also used in

wastewater processing for monitoring the effluent discharge. In most applications for open channel flow, weirs and flumes are used.

Open channel flow calculations are more complicated than pipe flow calculations because the location of the free-surface is often unknown 'a priori' (i.e., beforehand).

A. Types of Open Channel

There are various types of Open Channel. On the basis cross-section type, open channels are classified into two types: Prismatic Channels, and Non-Prismatic Channels.

➤ Prismatic Channel: -

If the cross-section of a channel is uniform along its length and the bottom slope is constant, it is called Prismatic Channels.

➤ Non-Prismatic Channel:

If the cross-section of a channel is non-uniform or the bottom slope is not constant, it is called Non-Prismatic Channels.

➤ Types of Prismatic Channel: -

• Rectangular Section: -

Rectangular Channel is an open channel with a rectangular cross section.

• Trapezoidal Section: -

Trapezoidal Channel is an open channel with a trapezoidal cross section where both sides have the same slope.

• Parabolic Section: -

The parabolic cross section shape is for many situations the best practical shape for an open channel. One of its advantages is the ability to maintain a higher velocity at low discharge which reduces the tendency to deposit sediment.

- *Triangular Section*

Triangular Section is an open channel with a triangular cross section.

B. Compound Channel

Compound channel consists of a main channel, which accommodates normal flows, flanked on one or both sides by a flood plain which is inundated during high flows.

Both channel roughness and the depth of the flow, and hence flow- channel geometry, can be drastically different in the main channel and the floodplains. In general, floodplain flows are relatively shallow, with slow-moving flow adjacent to faster-moving flow in the main channel, which results in a complex interaction that includes momentum transfer between the main-channel and floodplain flows.

➤ *Types of Open Channel Flow*

- *Steady and Unsteady Flow:*

When flow characteristics in an open channel flow, such as depth, velocity, and discharge at a certain place in the fluid, remain constant across time, the flow is referred to as steady flow.

If the fluid's velocity is represented by v , its rate of flow by Q , and its depth by d , then for a steady flow:

$$dv/dt = 0; dQ/dt = 0; dy/dt = 0;$$

If, during an open channel flow, any of the flow parameters—such as depth, velocity, and rate of flow in relation to time, the flow is said to as unsteady. Thus, it is provided by:

$$dv/dt, dQ/dt \text{ and } dy/dt \neq 0$$

- *Uniform Flow and Non-Uniform Flow:*

If, across a specific channel length, both the depth and the velocity of the flow stay consistent, the flow in the channel is considered uniform. i.e.

$$dy/dl = 0 ; dv/dl=0;$$

The flow characteristics of a non-uniform flow, such as velocity and depth of flow, do not stay consistent along the course of the channel.

$$dy/dl \text{ and } dv/dl \neq 0$$

- *Laminar Flow and Turbulent Flow:*

In open channel flow, laminar and turbulent flow are described by the Reynolds Number, or Re . The following connection yields the Reynolds number: $Re = \rho VR / \mu$

ρ = Density of water

μ = Viscosity of water

R = Hydraulic Radius or Hydraulic Mean Depth

V = Mean Velocity of Flow of Water

Laminar flow is the term used to describe a flow where the Reynolds number (Re) is less than 500 or 600. A turbulent flow is one where the Reynolds number is greater than 2000. A flow is said to be in the transition condition if its Reynolds number falls between 500 and 2000.

- *Critical, Sub-Critical and Super – Critical Flow:*

Depending on the Froude number Fe , the open channel flow can be classified as critical, sub-critical, or super-critical. The relationship yields the Froude number:

$$Fe = V / \sqrt{gD}$$

Where:

V = Mean Velocity of Flow of Water

D = Hydraulic Depth of Channel = Wetted Area / Top Width of Channel = A/T

T = Top Width of Channel

Critical flows are those that occur in open channels and have a Froude number of one. Furthermore, the Froude number of super-critical flow in an open channel is bigger than 1. Another name for a supercritical flow is a blazing, torrential, or fast flow.

II. ANALYSIS OF THE PROBLEM

The formulae and equations that governs various open channel flow parameters like the Discharge, Critical Depth, Normal Depth and Froude No are quite complex and requires a lot of variables. Manual Calculation of these parameters can lead to erroneous values, can be tedious and a slight mistake in calculation of any variable can affect the entire calculation. The calculation further complexify when the area of the channel is more. While the construction work of various hydraulic structures, irrigation weirs, canal system takes place it is essential to find the values of this flow parameter for safety of the structure and also efficient flow of fluid (mainly water) through these structures.

So, we have formulated the major equations and formulae that are essential for calculation of these flow parameters through programs using MATLAB. These programs can be used by various institutions, companies, researchers and individuals for easy and fast calculations. Values used in these programs are in standard units. These programs have high degree of accuracy and the outputs are quite precise. Easy and Quick calculation of various factors will lead to minimize human errors, save a hefty amount of time that can be used in variety of ways.

These will help in saving both money and power and hence will be a better tool that can be used by masses(1),(2)

III. COMPUTATION OF OPEN CHANNEL FLOW PARAMETERS USING MATLAB

Now it is the time to compute various open channel flow parameters that are essential for effective and efficient management of various open channels, determine the type of flow and the energy of flow that will help us to monitor these open channels in various industrial and agricultural sectors.

A. Discharge Calculation in Open Channels

Discharge is the volume of water flowing through a river channel. This is the total volume of water flowing through a channel at any given point and is measured in cubic metres per second (cumecs). The discharge from a channel depends on various factors.

Additionally, why is stream water quality important? The quantity of streamflow (also called "discharge") is an important factor in determining water quality and, thus, in interpreting water-quality data. The potential effects of contaminants on drinking- water supplies and aquatic habitats depend largely on the amount of water flowing in streams(3),(4).

There are several factors that affect stream discharge. The velocity of the water affects it; faster water means

%Program to find discharge of simple channel

clear all

opt=input('\nSelect the type of channel.\n1.Rectangular\n2.Triangular\n3.Trapezoidal');

if opt==1

B = input('\nEnter the width of Channel:'); y = input('\nEnter the depth of flow:');

n = input('\nEnter the Mannings Coefficient:');

S = input('\nEnter the bed slope:'); A = B*y;

P = B+(2*y); R = A/P;

Q = (1/n)*A*(R^(2/3))*(S^(1/2));

elseif opt==2

B = input('\nEnter the base width of Channel:');

y = input('\nEnter the depth of flow:'); n = input('\nEnter the Mannings Coefficient:');

S = input('\nEnter the bed slope:'); A = (1/2)*B*y;

P = (((B/2)^2)+(y^2))^(1/2)+B; R = A/P;

Q = (1/n)*A*(R^(2/3))*(S^(1/2));

elseif opt==3

T= input('\nEnter the top width of Channel:');

more passes per second so more discharge. The width and depth of the river also affects it; a larger river at the same speed will have higher discharge.

The discharge of water flowing in a channel is measured using stream gauges or can be estimated by the Manning equation.

$$Q = VA \quad V = \frac{k}{n} \left(\frac{A}{P} \right)^{2/3} S^{1/2}$$

k is a unit conversion factor: k=1.49 for English units (feet and seconds). k=1.0 for SI units (meters and seconds).

A=Flow area of the pipe, culvert, or channel.

P=Wetted perimeter which is the portion of the circumference that is in contact with water.

Q=Discharge (flow rate).

S=Downward (longitudinal) slope of the culvert.

V=Average velocity in the pipe, culvert, or channel. Now let us represent this in a MATLAB Model.

```

b = input('\nEnter the base width of Channel:');
y = input('\nEnter the depth of flow:'); n = input('\nEnter the Mannings Coefficient:');
S = input('\nEnter the bed slope:'); A = (1/2)*(b+T)*y;
B = (T-b)/2;
P = (((B/2)^2)+(y^2)^(1/2))*2+b+T; R = A/P;
Q = (1/n)*A*(R^(2/3))*(S^(1/2));
end

fprintf('\nThe discharge in the channel is %s',Q);

%Program to find discharge of compound channel clc clear all

opt=input('\nSelect the type of channel.\n1.Symmetrical Rectangular Compound Channel\n2
Symmetrical Trapezoidal Compound Channel. ');

if opt==1
end

P2 = Bf+(((Bf-Bf)^2)+((Y-Ym)^2))^0.5; R1 = A1/P1;
R2 = A2/P2;
Q1 = (1/nm)*A1*(R1^(2/3))*(Sm^(1/2));
Q2 = (1/nf)*A2*(R2^(2/3))*(Sf^(1/2)); Q = Q1+(2*Q2);
Bm = input('\nEnter the width of main Channel:');
Bf = input('\nEnter the width of flood plain:');
Y = input('\nEnter the depth of flow:');
Ym = input('\nEnter the depth of main channel:');
nm = input('\nEnter the Mannings Coefficient of main channel:');
nf = input('\nEnter the Mannings Coefficient of flood plain:');
Sf = input('\nEnter the bed slope of flood plain:');
Sm = input('\nEnter the bed slope of main channel:');
A1 = Bm*Y;
A2 = Bf*(Y-Ym); P1 = Bm+(2*Ym); P2 = Bf+2*(Y-Ym); R1 = A1/P1;
R2 = A2/P2;
Q1 = (1/nm)*A1*(R1^(2/3))*(Sm^(1/2));
Q2 = (1/nf)*A2*(R2^(2/3))*(Sf^(1/2)); Q = Q1+(2*Q2);
else opt==2

```

```

Bm = input('\nEnter the base width of main Channel:');
Bf = input('\nEnter the width of flood plain:');
Y = input('\nEnter the depth of flow:');
Ym = input('\nEnter the depth of main channel:');
nm = input('\nEnter the Mannings Coefficient of main channel:');
nf = input('\nEnter the Mannings Coefficient of flood plain:');
Sf = input('\nEnter the bed slope of flood plain:');
Sm = input('\nEnter the bed slope of main channel:');
SIm= input('\nEnter the side slope of main Channel in form of 1V: Hform:');
SIf= input('\nEnter the side slope of flood plain in form of 1V: Hform:');
Bfm= Bm+ (SIm*Ym);
Bff= (2*(Y-Ym)*SIf)+(2*Bf);
A1 = (Bfm*(Y-Ym))+((0.5*Ym*(Bfm+Bm)));
A2 = 0.5*(Y-Ym)*(Bf+Bff);
P1 = Bm+((Ym^2)+(((Bfm-Bm)/2)^2)^0.5)*2;
fprintf('\nThe discharge in the channel is %s',Q);

```

B. Critical Depth of Channel Section

Definitions Critical depth: -The variation of specific energy with depth at a constant discharge shows a minimum in the specific energy at a depth called critical depth at which the Froude number has a value of one. Critical depth is also the depth of maximum discharge, when the specific energy is held constant

➤ Importance of Critical Depth

Critical depth is an important value in hydraulic analysis because it is a control in reaches of non-uniform flow whenever the flow changes from subcritical to supercritical.

During the water surface profile calculations, we may need to calculate critical depth at a cross section if any of the following conditions occur:

- The supercritical flow regime has been specified by the user.
- Calculations of critical depth have been requested by the user.
- The current cross section is an external boundary cross section and critical depth must be determined to ensure the user-entered boundary condition is in the correct flow regime.
- The Froude number check for a subcritical profile indicates that critical depth needs to be determined to verify the flow regime of the computed water surface

elevation.

➤ The State of Flow and Critical Depth of Rivers also be Needed to Determine:-

- Rivers bring in mud, sand, silt, clay & organic debris from head waters
- The settling velocity of all these materials are different. For e.g. settling velocity of sand is higher than say mud.

The flow of water will determine the extent of displacement of these particles.

So, depending upon both these physical parameters, it can be ascertained how much will be the displacement & settlement of these various items.

For settlements, depth of the river will say how much of these items have settled.

➤ Application of Critical Depth

Critical depth is an essential parameter for the design, operation, and maintenance of conduits. Circular, arched, and egg-shaped sections are often used in non-pressure conduits in hydraulic engineering, irrigation, and sewerage works.

The critical depth is a hydraulic factor of the flow, it plays a particularly important role in studying and designing for open channels, especially during identification of water surfaces and analyzing to determine the phenomenon of a hydraulic jump in open channel. In practice, when calculating the critical depth, only the rectangular and isosceles triangle channels have the theory equation, in other circumstances in calculating by semi empirical equations(5).

➤ *Hydraulic Jump is Practical Application of Critical Depth:-*

The hydraulic jump consists of an abrupt rise of the water surface in the region of impact between rapid and tranquil flows. Flow depths before (supercritical depth, d_1) and after (subcritical depth, d_2) the jump are less than and

greater than critical depth, respectively. When the slope of open channel decreases from steep to mild, the depth of flow of water increases toward the critical depth and a flow instability occurs at some point. The flow becomes turbulent until the new normal depth is attained in the downstream. This is called a hydraulic jump.

The hydraulic jump is the most commonly used choice of design engineers for energy dissipation below spillways and outlets. A properly designed hydraulic jump can provide for 60-70% energy dissipation of the energy in the basin itself, limiting the damage to structures and the streambed.

➤ *Critical Depth of Simple Channels*

%Program to calculate the critical depths of simple channels

clear all;

Q = input('Enter the Discharge of channel (in m³/s:');

opt=input('\nSelect the type of channel.\n1.Rectangular\n2.Triangular\n3.Parabol a')

if opt==1

B = input('\nEnter the width of Channel:'); q = Q/B;

yc = ((q²)/9.81)^(1/3);

elseif opt==2

m = input('\nEnter the Slide slope(in H/V:');

yc = 0.73*((Q/m)^(2/5)); yc=num2str(yc);

elseif opt==3

T= input('\nEnter the bed slope of the channel:');

yc = (3.375*((Q/T)²)/9.81)^(1/4);

yc=num2str(yc);

end

fprintf('\nValue of Critical Depth of Section is %s',yc);

➤ *Critical Depth of Compound Channels*

Here we have only considered Symmetrical RECTANGULAR compound channel section.

%Program to find Critical Depth of a symmetrical Rectangular Compound

%channel with uniform flow. clc

clear all

Q=input('Enter the value of Discharge:'); Bm=input('Enter the Breadth of main channel:');

```

Bf=input('Enter the Breadth of flood plain:'); Ym=input('Enter the depth of main channel:');
nr=input('Enter the roughness of channel:'); bf=Bf/Ym;
br=Bf/Bm;
y = linspace(1,1.3,300); c = [1];
for i = 1:300
if i==1
f=1;
Cmax=1; else
A2=Bf*(y(i)-Ym)*2; A1=Bm*y(i); P2=(Bf+(y(i)-Ym))*2; P1=2*Ym+Bm;
m=1/(1+(2*nr*((A2/A1)^(5/3))*((P1/P2)^(2/3))));
e1 = (1/(y(i)+((2*br)*(y(i)-1))));
e2 = ((m/y(i))^2)+(((1-m)/(y(i)- 1))^2)*(1/(2*br));
e3 = (2*m*(1-m))/(3*(y(i)+(2*br*(y(i)-1))));
e4 = (5/(y(i)*(y(i)-1)))-(2/(bf+y(i)-1));
e5 = (m/y(i))-((1-m)/((y(i)-1)*2*br)); f = e1*e2+(e3*e4*e5);
if f>Cmax
Cmax=f;
end
c = [c f];
end
end plot(y,c);
u=num2str(Cmax);
fprintf('\nValue of C max is: %s',u); C_beg = interp1(y,c,y(1));
C_end = interp1(y,c,y(300)); k=(9.81*(Bm^2)*(Ym^3))/(Q^2); p=num2str(k);
fprintf('\nValue of K is:%s',p); if isreal(Cmax) == 0
fprintf("The value of Cmax is imaginary \n Verify the input values");
else
if (k<1)
yc1 = interp1(c,y,k); yc1 = num2str(yc1);
fprintf('\n The critical depth will lie in flood plain. ');
fprintf('\n Value of Yc1: %s',yc1);

```



```

elseif (k>1 && k<Cmax) yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);
yc1 = num2str(yc1);

fprintf('\nHere we have 3 critical depths.Two critical depths above flood plain and one
critical depth below flood plain\n ');

fprintf('\n The critical depth below flood plain-');

fprintf('\nValue of Yc1 is: %s',yc1);

fprintf('\n The critical depths above flood plain-');

y_max = interp1(c,y,Cmax); if y_max>0
Y_1 = y(y<=y_max); n_1 = length(Y_1);

C_1 = linspace(C_beg,Cmax,n_1); %to generate equal no of elements as in Y_1 within range y(1)
to y_max

%disp(Y_1);

%disp(C_1);

yc2 = interp1(C_1,Y_1,k); yc2 = num2str(yc2);

fprintf('\n Value of Yc2 is: %s',yc2); Y_2=y(y>=y_max);
n_2 = length(Y_2);

C_2 = linspace(Cmax,C_end,n_2); yc3 = interp1(C_2,Y_2,k);
yc3 = num2str(yc3);

fprintf('\n Value of Yc3 is: %s',yc3); else
disp('\n Value of yc2 is imaginary');

end

%('C=K Pain y ra values yc2 aau yc3 re store haba')

elseif (k>Cmax)

fprintf('\nIn this region there is only one critical depth and it is less than the depth at
flood plain--');

yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);

yc1 = num2str(yc1);

fprintf('Value of Yc1 is: %s',yc1);

end end

% If you find any value as NaN,then there are no critical depth or check
% flow parameters once gain

Here the critical depth is calculated from C vs y graph.

```


C. Flow Stage in Open Compound Channel

%Program to CHECK FLOW STAGE of a symmetrical Rectangular Compound

%channel with uniform flow. clc

clear all

Q=input('Enter the value of Discharge:'); Bm=input('Enter the Breadth of main channel:');

Bf=input('Enter the Breadth of flood plain:'); Ym=input('Enter the depth of main channel:');

nr=input('Enter the roughness of channel:'); bf=Bf/Ym;

br=Bf/Bm;

y = linspace(1,1.3,300); c = [1];

for i = 1:300

if i==1

f=1;

Cmax=1; else

A2=Bf*(y(i)-Ym)*2; A1=Bm*y(i); P2=(Bf+(y(i)-Ym))*2; P1=2*Ym+Bm;

m=1/(1+(2*nr*((A2/A1)^(5/3))*((P1/P2)^(2/3))));

e1 = (1/(y(i)+((2*br)*(y(i)-1))));

e2 = ((m/y(i))^2)+(((1-m)/(y(i)- 1))^2)*(1/(2*br));

e3 = (2*m*(1-m))/(3*(y(i)+(2*br*(y(i)-1))));

e4 = (5/(y(i)*(y(i)-1)))-2/(bf+y(i)-1));

e5 =(m/y(i))-((1-m)/((y(i)-1)*2*br)); f = e1*e2+(e3*e4*e5);

if f>Cmax

Cmax=f;

end

c = [c f];

end

end

u=num2str(Cmax);

fprintf('\nValue of C max is: %s',u); C_beg = interp1(y,c,y(1));

C_end = interp1(y,c,y(300)); k=(9.81*(Bm^2)*(Ym^3))/(Q^2); p=num2str(k);

fprintf('\nValue of K is:%s',p); if isreal(Cmax) == 0

fprintf("The value of Cmax is imaginary \n Verify the input values");

else

if(k<1)

yc1 = interp1(c,y,k); yc1 = num2str(yc1);

fprintf('\n The critical depth will lie in flood plain.');

fprintf('\n Value of Yc1: %s',yc1);

Y=input('\nEnter the depth of flow to check flow at this stage stage:');

yc1 = interp1(c,y,k); q=((yc1^3)*9.81)^(1/2);

Fr=q/(Y*((9.81*Y)^(1/2)));

if (Fr<1)

fprintf('\n The flow is Subcritical'); elseif (Fr==1)

fprintf('\n The flow is critical'); elseif (Fr>1)

fprintf('\n The flow is Supercritical');

end

elseif (k>1 && k<Cmax) yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);

yc1 = num2str(yc1);

fprintf('\nHere we have 3 critical depths.Two critical depths above flood plain and one critical depth below flood plain\n ');

fprintf('\n The critical depth below flood plain-');

fprintf('\nValue of Yc1 is: %s',yc1); yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);

Y=input('\nEnter the depth of flow to check flow at this stage:');

q=((yc1^3)*9.81)^(1/2);

Fr=q/(Y*((9.81*Y)^(1/2)));

if (Fr<1)

fprintf('\n The flow is Subcritical'); elseif (Fr==1)

fprintf('\n The flow is critical'); elseif (Fr>1)

fprintf('\n The flow is Supercritical'); end

fprintf('\n The critical depths above flood plain-');

y_max = interp1(c,y,Cmax);

if y_max>0

Y_1 = y(y<=y_max); n_1 = length(Y_1);

C_1 = linspace(C_beg,Cmax,n_1); %to generate equal no of elements as in Y_1 within range y(1) to y_max

```

%disp(Y_1);
%disp(C_1);
yc2 = interp1(C_1,Y_1,k); yc2 = num2str(yc2);
fprintf('\n Value of Yc2 is: %s',yc2);
Y=input('\nEnter the depth of flow to check flow stage:');
yc2 = interp1(C_1,Y_1,k); q=((yc2^3)*9.81)^(1/2);
Fr=q/(Y*((9.81*Y)^(1/2)));
if (Fr<1)
fprintf('\n The flow is Subcritical'); elseif (Fr==1)
fprintf('\n The flow is critical'); elseif (Fr>1)
fprintf('\n The flow is Supercritical'); end
Y_2 = y(y>=y_max); n_2 = length(Y_2);
C_2 = linspace(Cmax,C_end,n_2); yc3 = interp1(C_2,Y_2,k);
yc3 = num2str(yc3);
fprintf('\n Value of Yc3 is: %s',yc3);
Y=input('\nEnter the depth of flow to check flow stage:');
yc3 = interp1(C_2,Y_2,k); q=((yc3^3)*9.81)^(1/2);1.6
Fr=q/(Y*((9.81*Y)^(1/2)));
if (Fr<1)
fprintf('\n The flow is Subcritical'); elseif (Fr==1)
fprintf('\n The flow is critical'); elseif (Fr>1)
fprintf('\n The flow is Supercritical'); end
else
disp('\n Value of yc2 is imaginary');
end
%('C=K Pain y ra values yc2 aau yc3 re store haba')
elseif (k>Cmax)
fprintf('\nIn this region there is only one critical depth and it is less than the depth at
flood plain--');
yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);
yc1 = num2str(yc1);

```

```

fprintf('\n Value of Yc1 is: %s',yc1);
Y=input('\nEnter the depth of flow to check flow stage:');
yc1=((Q^2)/(9.81*(Bm^2)))^(1/3);
end end
q=((yc1^3)*9.81)^(1/2);
Fr=q/(Y*((9.81*Y)^(1/2)));
if (Fr<1)
fprintf('\n The flow is Subcritical'); elseif (Fr==1)
fprintf('\n The flow is critical'); elseif (Fr>1)
fprintf('\n The flow is Supercritical');
end

```

D. Critical Depth of Channel Sections

➤ Critical Depth of Simple Channel

Enter the Discharge of channel (in m³/s): 15

Select the type of channel.

- Rectangular
- Triangular

% If you find any value as NaN, then there are no critical depth or check

% flow parameters once gain

IV. RESULTS ANALYSIS

A. Discharge Calculation in Simple Channels

Here we have taken just one example to verify results-

➤ Select the Type of Channel.

- Rectangular
- Triangular
- Trapezoidal

Enter the width of Channel: 3

Enter the depth of flow: 2

Enter the Manning's Coefficient: 0.013

Enter the bed slope: 0.001

The discharge in the channel is
1.316972e+01

Now calculating manually, we get Discharge as 13.169 cumec. So there are no error comparing to the theoretical values.

Parabola

Enter the Slide slope (in H/V): 0.05

➤ Critical Depth of Compound Channel

Enter the value of Discharge: 5

Enter the Breadth of main channel: 1

Enter the Breadth of flood plain: 3

Enter the depth of main channel: 1

Enter the roughness of channel: 0.9

Value of C max is: 4.1404 Value of K is:
0.3924

The critical depth will lie in flood plain. Value of Y_{c1} : 1.224

C is the function of y_r, b_r, n_r and b_f

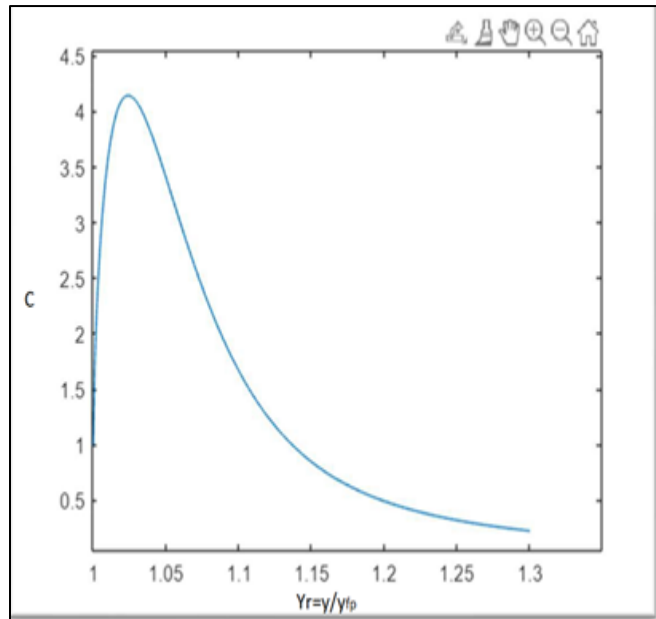


Fig 1 Graph between C and y_r in Compound Channel Flow

B. Flow Stage In Open Compound Channel

Enter the value of Discharge: 3

Enter the Breadth of main channel: 1

Enter the Breadth of flood plain: 2

Enter the depth of main channel: 1

Enter the roughness of channel: 0.7

Value of C max is: 2.9056 Value of K is:1.09

Here we have 3 critical depths.Two critical depths above flood plain and one critical depth below flood plain.

The critical depth below flood plain- Value of Y_{c1} is: 0.97168

Enter the depth of flow to check flow at this stage: 0.7

The flow is Supercritical.

The critical depths above flood plain- Value of Y_{c2} is: 1.0015

Enter the depth of flow to check flow stage: 1

The flow is Supercritical Value of Y_{c3} is: 1.2199

Enter the depth of flow to check flow stage: 0.9

ans =1.6000

The Flow is Supercritical

V. CONCLUSIONS

The results we have got in this program have a high degree of theoretical accuracy; however various external factors have not been taken into consideration so therefore the actual values might differ from the values obtained in this program. This program will be of great help for students, teachers and research officials who use manual calculations for educational and research purposes.

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