

Flow In Open Channels

4th Edition

**DEVELOPMENT OF FLOW RATE
MEASUREMENT ON OPEN
CHANNEL FLOW ...**
flow through open channel -

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SlideShare

**Open Channel flow is a bit different than for closed conduits. 3 Uniform Flow
Friday, November 2, 2012
Flow in Open Channel - Flow Conditions ! For our purposes, we will assume that transition**

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**occurs at a Reynolds number
of 1000. ! Most common open-
channel flows are turbulent. 4
Uniform Flow Friday,
November 2, 2012
The open channel flow
calculator Select Channel
Type: Trapezoid Triangle**

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**Rectangle Circle Select
parameter for solving
Velocity(V)&Discharge(Q)
Channel slope from V Channel
slope from Q Manning
Coefficient from V Manning
Coefficient from Q Depth from
Q RightSlope from Q Even**

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slope from Q LeftSlope from Q

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K ...**

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CHAPTER 4 FLOW IN CHANNELS INTRODUCTION 1
Flows in conduits or channels are of interest in science, engineering, and everyday life. Flows in closed conduits or channels, like pipes or air ducts, are entirely in contact

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with rigid boundaries. Most closed conduits in engineering applications are either circular or rectangular in cross section.

CHAPTER 4 FLOW IN CHANNELS - MIT

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The open channel flow
calculator Select Channel
Type: Trapezoid Triangle
Rectangle Circle Select
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Velocity(V)&Discharge(Q)
Channel slope from V Channel

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**slope from Q Manning
Coefficient from V Manning
Coefficient from Q Depth from
Q RightSlope from Q Even
slope from Q LeftSlope from Q**

**Open Channel Flow Calculator
Open Channel Flow • Consider**

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**a small disturbance in a flow
with a free surface -
Hydrostatic pressure -
Atmospheric pressure at free
surface • Mass and
momentum conservation over
a control volume • Long
waves assumed (like shallow**

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water waves)

**Open Channel Flow -
University of Notre Dame
OPEN CHANNEL FLOW: PIPE
FLOW: 1: Flow occurs due to
gravity . Flow occurs due to
different in pressure . 2: The**

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maximum velocity occurs at a little distance below the water surface. The maximum velocity occur at the center of the pipe . 3. Cross section of open channel can be trapezoidal, triangular, rectangular

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,circular etc.

DIFFERENCES BETWEEN PIPE FLOW AND OPEN CHANNEL FLOW

**Figure 2.4 channel transition
with a hump Since the flow is
subcritical, the water surface**

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will drop due to a decrease in the specific energy. In figure 2.5, the water surface which was at P at section 1 will come down to point R at section 2. The depth y_2 will be given by:

$$\frac{Q^2}{2gB^2y^3} + \frac{V^2}{2g} + E = \frac{Q^2}{2gB^2y_1^3} + \frac{V_1^2}{2g} + E_1$$

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Fig 2.5 Specific energy diagram

2. The Energy Principle in Open Channel Flows

INTRODUCTION An open channel is a waterway, canal or conduit in which a liquid

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flows with a free surface. A channel is open or closed as long as its surface is exposed to constant pressure. In the absence of any other channel control, the flow is controlled only by friction with the bed and the sides of the channel.

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3 4. TYPES OF OPEN CHANNEL

Natural flows: rivers, creeks, floods, etc. Human-made systems: fresh-water aqueducts, irrigation, sewers, drainage ditches, etc. 4

flow through open channel -

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4) HGL is coincident with the free surface. 5) Flow area is determined by the geometry of the channel plus the level of free surface, which is likely to change along the flow direction and with as well as

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time. 1) No free surface in pipe flow. 2) No direct atmospheric pressure, hydraulic pressure only.

OPEN-CHANNEL FLOW
4 Flow in Open Channels:
Manning Equation Manning's

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**equation is used to relate the average channel (conduit) velocity to energy loss, $S_f = hf/L$. Manning equation (metric units: m, s) UNITS ?!!!
Does “n” have units?
Tabulated values? 3.7
Manning Equation (Cont.)**

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**General case To change to US
Customary units multiply by =
1 (metric) or 1.486 (English)
3.8**

3.2 Topic 8: Open Channel Flow

Open-channel flow, a branch

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of hydraulics and fluid mechanics, is a type of liquid flow within a conduit with a free surface, known as a channel. The other type of flow within a conduit is pipe flow. These two types of flow are similar in many ways but

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differ in one important respect: the free surface. Open-channel flow has a free surface, whereas pipe flow does not.

Open-channel flow - Wikipedia
A) An open-channel flow for

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which was addressed at length in Chapter 4.

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**Edition: K. Subramanya ...
Open channel flow takes
place in natural channels like
rivers and streams. It also
occurs in manmade channels
such as those used to
transport wastewater and in
circular sewers flowing**

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**partially full. In this course
several aspects of open
channel flow will be
presented, discussed**

**Uniform Open Channel Flow
and the Manning Equation
Chapter 4 Open-Channel Flow**

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4-1 Introduction An open channel is a watercourse that allows part of the flow to be exposed to the atmosphere. This type of channel includes rivers, culverts, stormwater systems that flow by . gravity, roadside ditches, and

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roadway gutters. Open-channel flow design criteria are used in the following areas of transportation design:

Chapter 4 Open-Channel Flow
This paper presents the

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velocity profiles and the accurate flow rate measurements on open channel flow using Ultrasonic Doppler method. In this study, the accurate flow rate was calculated by integrating the velocity distributions over

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the cross section. The flow rate measurements were carried out on three different conditions. The

DEVELOPMENT OF FLOW RATE MEASUREMENT ON OPEN CHANNEL FLOW ...

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**Open Channel flow is a bit
different than for closed**

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**conduits. 3 Uniform Flow
Friday, November 2, 2012
Flow in Open Channel - Flow
Conditions ! For our purposes,
we will assume that transition
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of 1000. ! Most common open-
channel flows are turbulent. 4**

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**Uniform Flow Friday,
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**Uniform Flow in Open Channel
- University of Memphis
BASIC HYDRAULIC PRINCIPLES
OF OPEN-CHANNEL FLOW by
Harvey E. Jobson and David C.**

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Froehlich ABSTRACT The three basic principles of open-channel-flow analysis the conservation of mass, energy, and momentum are derived, explained, and applied to solve problems of open-channel flow. These

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principles are introduced at a

**BASIC HYDRAULIC PRINCIPLES
OF OPEN-CHANNEL FLOW**

**Open Channel Flow and Water
Surface Profiles:**

**Fundamentals of Hydraulic
Engineering , A.L. Prasuhn,**

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**Holt, Rinehart and Winston,
1987, Chapter 7, Open
Channel Hydraulics (pp. 191
-264). “State of flow in open
channels, as determined by
Reynolds and Froude
numbers” (handout notes)**

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BASIC HYDRAULIC PRINCIPLES OF OPEN-CHANNEL FLOW

4) HGL is coincident with the free surface. 5) Flow area is determined by the geometry of the channel plus the level of free surface, which is likely to change along the flow direction and with as well as time. 1) No free surface

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2. The Energy Principle in Open Channel Flows

A) An open-channel flow for which the water-surface slope is less than the slope of the channel bottom. B) An open-channel flow for which the water-

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CHAPTER 5 OPEN-CHANNEL
FLOW - MIT OpenCourseWare
3.2 Topic 8: Open Channel Flow
CHAPTER 4 FLOW IN
CHANNELS INTRODUCTION 1
Flows in conduits or channels
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BASIC HYDRAULIC PRINCIPLES
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Open-channel flow - Wikipedia

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Introduction An open channel is a watercourse that allows part of the flow to be exposed to the atmosphere. This type of channel includes rivers, culverts, stormwater systems that flow by . gravity, roadside ditches, and roadway gutters. Open-channel flow design criteria are used in the following

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*areas of transportation design:
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*4 Flow in Open Channels:
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Manning Equation Manning's equation is used to relate the average channel (conduit) velocity to energy loss, $S_f = hf/L$. Manning equation (metric units: m, s) UNITS ?!!? Does "n" have units? Tabulated values? 3.7

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Manning Equation (Cont.)
General case To change to US
Customary units multiply by = 1
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OPEN-CHANNEL FLOW
Uniform Flow in Open Channel -
University of Memphis

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CHANNELS INTRODUCTION 1
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CHAPTER 4 FLOW IN CHANNELS - MIT

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The open channel flow calculator

Select Channel Type: Trapezoid

Triangle Rectangle Circle Select

parameter for solving

Velocity(V)&Discharge(Q)

Channel slope from V Channel

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slope from Q Manning
Coefficient from V Manning
Coefficient from Q Depth from Q
RightSlope from Q Even slope
from Q LeftSlope from Q

Open Channel Flow Calculator

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Open Channel Flow • Consider a small disturbance in a flow with a free surface – Hydrostatic pressure – Atmospheric pressure at free surface • Mass and momentum conservation over a control volume • Long waves

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assumed (like shallow water waves)

Open Channel Flow - University of Notre Dame

OPEN CHANNEL FLOW: PIPE

FLOW: 1: Flow occurs due to

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3. Cross section of open channel

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*can be trapezoidal,
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etc.*

***DIFFERENCES BETWEEN
PIPE FLOW AND OPEN
CHANNEL FLOW***

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Figure 2.4 channel transition with a hump Since the flow is subcritical, the water surface will drop due to a decrease in the specific energy. In figure 2.5, the water surface which was at P at section 1 will come down to point

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*R at section 2. The depth y_2 will
 be given by: $\frac{V^2}{2g} + y = \frac{V_1^2}{2g} + y_1$ Fig 2.5
 Specific energy diagram*

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3 4. TYPES OF OPEN

CHANNEL *Natural flows: rivers, creeks, floods, etc. Human-made systems: fresh-water aqueducts,*

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ditches, etc. 4*

*flow through open channel -
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OPEN-CHANNEL FLOW

4 Flow in Open Channels:

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Manning Equation (Cont.)
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*3.2 Topic 8: Open Channel Flow
Open-channel flow, a branch of
hydraulics and fluid mechanics,
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conduit with a free surface,*

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Open-channel flow - Wikipedia

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Open channel flow takes place in*
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*open channel flow will be
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*Uniform Open Channel Flow and
the Manning Equation*

Chapter 4 Open-Channel Flow

4-1 Introduction An open channel

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*Chapter 4 Open-Channel Flow
This paper presents the velocity profiles and the accurate flow*

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BASIC HYDRAULIC
PRINCIPLES OF OPEN-*

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CHANNEL FLOW by Harvey E. Jobson and David C. Froehlich
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***BASIC HYDRAULIC
PRINCIPLES OF OPEN-
CHANNEL FLOW***

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Open Channel Flow and Water Surface Profiles: Fundamentals of Hydraulic Engineering, A.L. Prasuhn, Holt, Rinehart and Winston, 1987, Chapter 7, Open Channel Hydraulics (pp. 191-264). "State of flow in open

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Reynolds and Froude numbers”
(handout notes)*

Open Channel Analysis

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Open Channel Flow Calculator

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Chapter 4 Open-Channel Flow
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DIFFERENCES BETWEEN
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Fig 2.5 Specific energy diagram

Uniform Open Channel Flow

and the Manning Equation
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