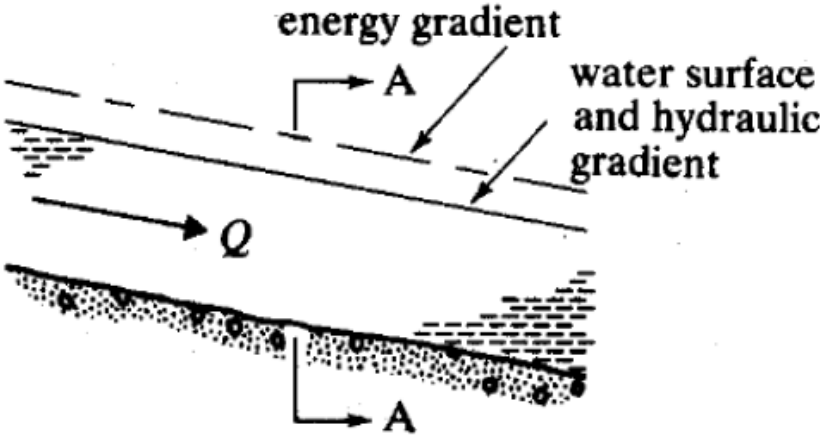
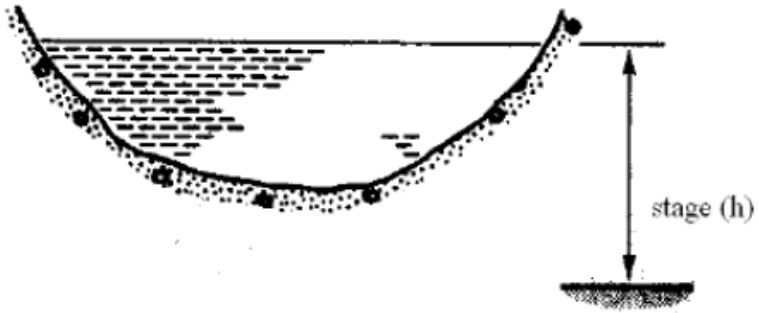
# Open channal

By Fitsume T.

- Open channel flow occurs where ever the flow proceeds with the liquid surface exposed to constant pressure.
- In practice this pressure is the atmospheric pressure, and the flow proceeds with free surface (exposed to the atmosphere).




**Channel flow**




**Cross section A–A**
area defined by
water surface level
and channel shape

## Open Channel Flow

- have a free space
- Subject to atmospheric pressure also
- Flow driven by gravity (potential Energy)
  - Unknown cross section (due to unknown depth)
- Flow depth computed using continuity and momentum equations
- Atmospheric Pressure as boundary condition

## Pipe Flow

- No free space
- Hydraulic pressure only
- Flow driven by pressure
- Known and fixed flow cross section
- Velocity deduced from continuity equation
- No boundary condition

- **Artificial channels/ Prismatic channels**
  - Man made
  - usually constructed in a regular cross-section shape throughout
  - Eg, **irrigation canals, navigation canals, spillways, sewers, culverts and drainage ditches**

- **Natural channels**
  - are channels that naturally exist or crated with natural system
  - surface roughness will often change with **time distance and even elevation**
  - more difficult to accurately analyze and obtain satisfactory results
  - Eg.**streams, rivers, floodplains**

# Flow classification

- Steady uniform flow, in which the depth is constant, both with time and distance. This constitutes the fundamental type of flow in an open channel in which the gravity forces are in equilibrium with the resistance forces.
- Steady non-uniform flow, in which the depth varies with distance, but not with time. The flow may be either (a) gradually varied requires the joint application of energy and frictional resistance equations or (b) rapidly varied requires the application of energy and momentum principles.
- Unsteady flow, in which the depth varies with both time and distance (unsteady uniform flow is very rare). This is the most complex flow type, requiring the solution of energy, momentum and friction equations through time.

# Classification based on Viscosity

- **The state or behavior of open channel flow is governed by the effects of viscosity relative to inertia**
- **Thus the open channel classified as**
  - **Laminar**
  - **Turbulent**
  - **Transitional**

$$\mathrm{Re}_{Pipe} = \frac{\rho U D}{\mu}$$

**Re > 4000 Turbulent**
**Re< 2000 laminar**
**2000 < Re < 4000 Transitional**

$$\mathrm{Re}_{Channel} = \frac{\rho U D}{4\mu} = \frac{\mathrm{Re}_{Pipe}}{4}$$

**Re > 1000 Turbulent**
**Re< 500 laminar**
**500 < Re < 1000 Transitionnel**