# Chapter 08 - Internal Incompressible Viscous Flow

* Entrance Length ()
  + For laminar flow,:
  + For turbulent flow:   
    the details of the turbulent motion may not be fully developed for **80** or more pipe diameters

## Fully Developed Laminar Flow

### Fully Developed Laminar Flow Between Infinite Parallel Plates

#### Both Plates Stationary

* Velocity distribution:   
   is the distance between two parallel plates.
* Shear Stress Distribution:
* Volumetric Flow Rate:  
   is the plate width. is the plate length.
* Average and Maximum Velocity:

#### Upper Plate Moving with Constant Speed,

* Velocity distribution:   
   is the distance between two parallel plates.
* Shear Stress Distribution:
* Volumetric Flow Rate:  
   is the plate width. is the plate length.
* Average Velocity:

#### Fully Developed Laminar Flow in a Pipe

* Velocity distribution:
* Shear Stress Distribution:
* Volumetric Flow Rate:  
   is the plate width. is the plate length.
* Average and Maximum Velocity:

## Flow in Pipes And Ducts

* Bernoulli Equation: (Frictionless!!)
* Flows in pipes and ducts experience large amounts of friction.
* Major Loses   
  Friction loses in constant pipe area sections
* Minor Loses   
  Loses due to components like valves or elbows.

#### Calculation of Head Loss

* Total head loss was caused by loss of mechanical energy and heat to thermal energy:

#### Major Losses

General Equation:

* Laminar Flow:
* Turbulent Flow:

#### Minor Losses

General Equation:

* Inlets and Exits.
* Enlargements and Contractions.
* Pipe Bends.
* Valves and Fittings.

#### Pumps, Fans, and Blowers in Fluid Systems

* The driving force for maintaining the flow against friction is a pump for liquids or a fan or blower for gases
* Pumps, Fans and Blowers can be accounted for as a negative loss.
* ,

#### Pipe Flow Solutions

Single-Path Systems:

* Find for a given , and (Example 8.5)
* Find for a given , and (Example 8.6)
* Find for a given , and (Example 8.7)
* Find for a given , and (Example 8.8)