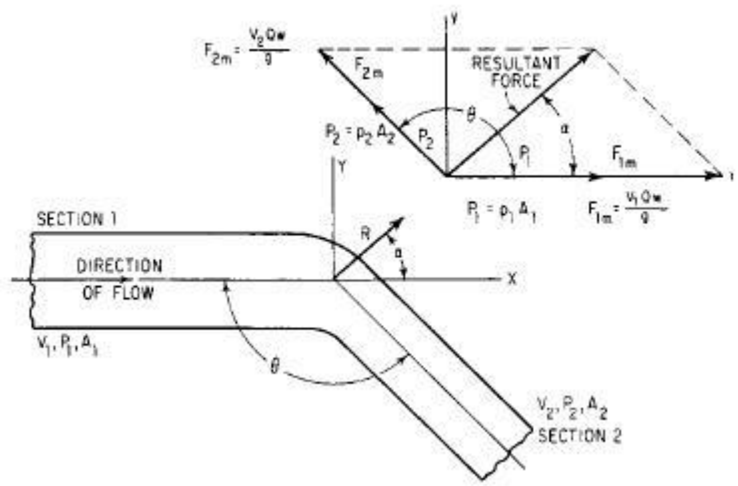
Forces Due To Pipe Bends

The momentum change and the unbalanced internal pressure of the water leads to forces on the pipes

The force diagram in figure is a convenient method for finding the resultant force on a bend. The forces can be resolved into X and Y components to find the magnitude and direction of the resultant force on the pipe.



V_1= velocity before change in size of pipe, ft /s (m/s)

V_2= velocity after change in size of pipe, ft /s (m/s)

p_1= pressure before bend or size change in pipe, lb/ft^2

(kPa)

p_2= pressure after bend or size change in pipe, lb/ft^2

(kPa)

A_1= area before size change in pipe, ft^2 (m^2)

A_2= area after size change in pipe, ft^2 (m^2)

F_{2m}= force due to momentum of water in section 2 V_2Qw/g

F_{1m}= force due to momentum of water in section 1 V_1Qw/g

P_2= pressure of water in section 2 times area of section 2 p_1 A_1

P_1= pressure of water in section 1 times area of section 1 p_1 A_1

w= unit weight of liquid, lb/ft^3 (kg/m^3)

Q= discharge, ft^3/s (m^3/s)

If the pressure loss in the bend is neglected and there is no change in magnitude of velocity around the bend,then

$R=2A[(wV^2/g)+p]$cosine of angle between pipes
where R resultant force on bend, lb (N)

p= pressure, lb/ft^2 (kPa)
w= unit weight of water, 62.4 lb/ft^3 (998.4 kg/m^3)
V= velocity of flow, ft/s (m/s)

g= acceleration due to gravity, 32.2 ft/s^2 (9.81 m/s^2)
A= area of pipe, ft^2 (m^2)

Source: http://www.engineeringcivil.com/forces-due-to-pipe-bends.html