JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTER

Class – B.Tech Civil (IV SEM)
Subject –Hydraulics Engineeging
Unit – 1
Presented by – Ashish Boraida (Assistant Professor)

VISION AND MISSION OF INSTITUTE

VISION OF INSTITUTE

To became a renowned centre of outcome based learning and work towards academic professional ,cultural and social enrichment of the lives of indivisuals and communities

MISSION OF INSTITUTE

Focus on evaluation of learining ,outcomes and motivate students to research apptitude by project based learning.

- Identify based on informed perception of indian ,regional and global needs ,the area of focus and provide plateform to gain knowledge and solutions.
-
- Offer oppurtunites for interaction between academic and industry .
- Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders may emerge.

VISION AND MISSION OF DEPARTMENT

Vision

To become a role model in the field of Civil Engineering for the sustainable development of the society.

Mission

1)To provide outcome base education.

2)To create a learning environment conducive for achieving academic excellence.

3)To prepare civil engineers for the society with high ethical values.

Introduction, Objective and Outcome of Fluid Mechanics

Objective:

,

The primary purpose of the study of Fluid mechanics is to develop the capacity to understand important basic terms used in fluid mechanics, understand hydrostatics and buoyancy with practice of solving problems. Student could be able to understand Kinematics of flow and fluid dynamics, Bernoulli's equation and laminar flow with practice of solving problems in practical life for the benefit of society and mankind.

Outcomes

- Student will be able to understand Dimensional, Model Analysis and Turbulent Flow with problems.
- Student will be able to understand variable Flow in open channels , Gradually and Rapidly Varied Flow.
- Student will be able to understand Impact of Jets and hydraulic machines
- Student will be able to understand Hydrology, Ground water and Canal Hydraulics.

CONTENTS

- Impact of Jets
- Impulse Momentum equation
- Various Cases

Introduction

Analysis and Design of Hydraulic Machines (Turbines and Pumps) is essentially based on the knowledge of forces exerted on or by the moving fluids.

Learning Objective:

Evaluation of force, both in magnitude and direction, by free jets (constant pressure throughout) when they impinge upon stationary or moving objects such as flat plates and vanes of different shapes and orientation.

Force exerted by the jet on a stationary plate

Impact of Jets

The jet is a stream of liquid comes out from nozzle with a high velocity under constant pressure. When the jet impinges on plates or vanes, its momentum is changed and a hydrodynamic force is exerted. Vane is a flat or curved plate fixed to the rim of the wheel

1.Force exerted by the jet on a stationary plate

a) Plate is vertical to the jet
b) Plate is inclined to the jet
c) Plate is curved

2. Force exerted by the jet on a moving plate

a) Plate is vertical to the jet
b) Plate is inclined to the jet
c) Plate is curved

Impulse-Momentum Principle

From Newton's 2nd Law:
$F = m\,a = m\,(V_1 - V_2) / t$

Impulse of a force is given by the change in momentum caused by the force on the body.

$Ft = mV_1 - mV_2$ = Initial Momentum – Final Momentum

Force exerted by jet on the plate in the direction of jet, $F = m\,(V_1 - V_2) / t$
= (Mass / Time) (Initial Velocity – Final Velocity)
$= (\rho Q)\,(V_1 - V_2) =$ **$(\rho a V)\,(V_1 - V_2)$**

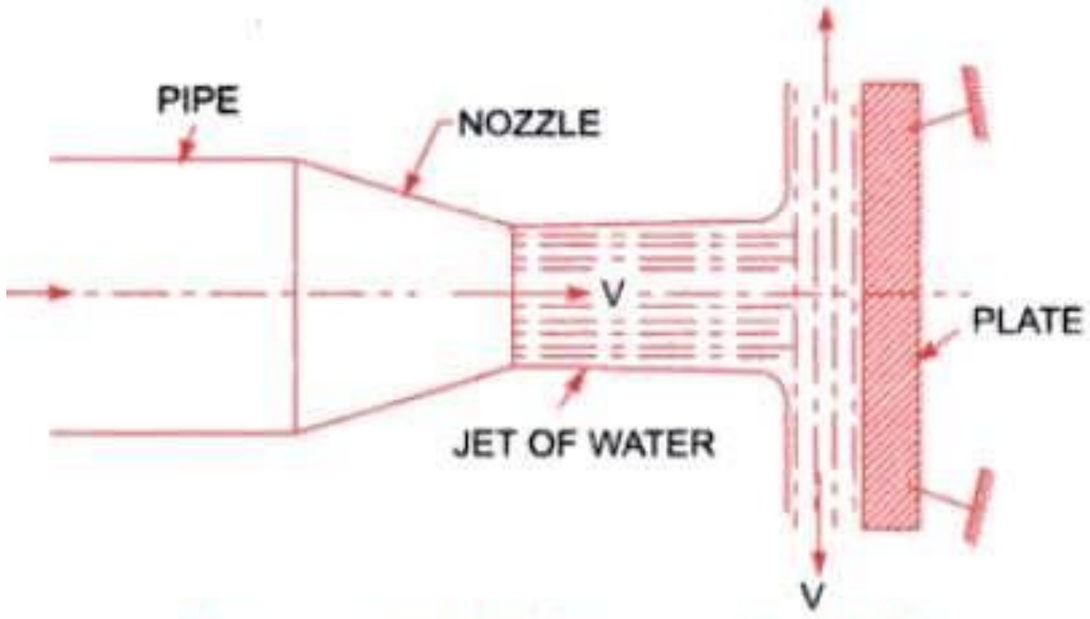
Force exerted by the jet on a stationary plate

Plate is vertical to the jet

$$F = \rho a V^2$$

If Plate is moving at a velocity of ‘U’ m/s,

$$F = \rho a (V-U)^2$$



Force exerted by jet on vertical plate.

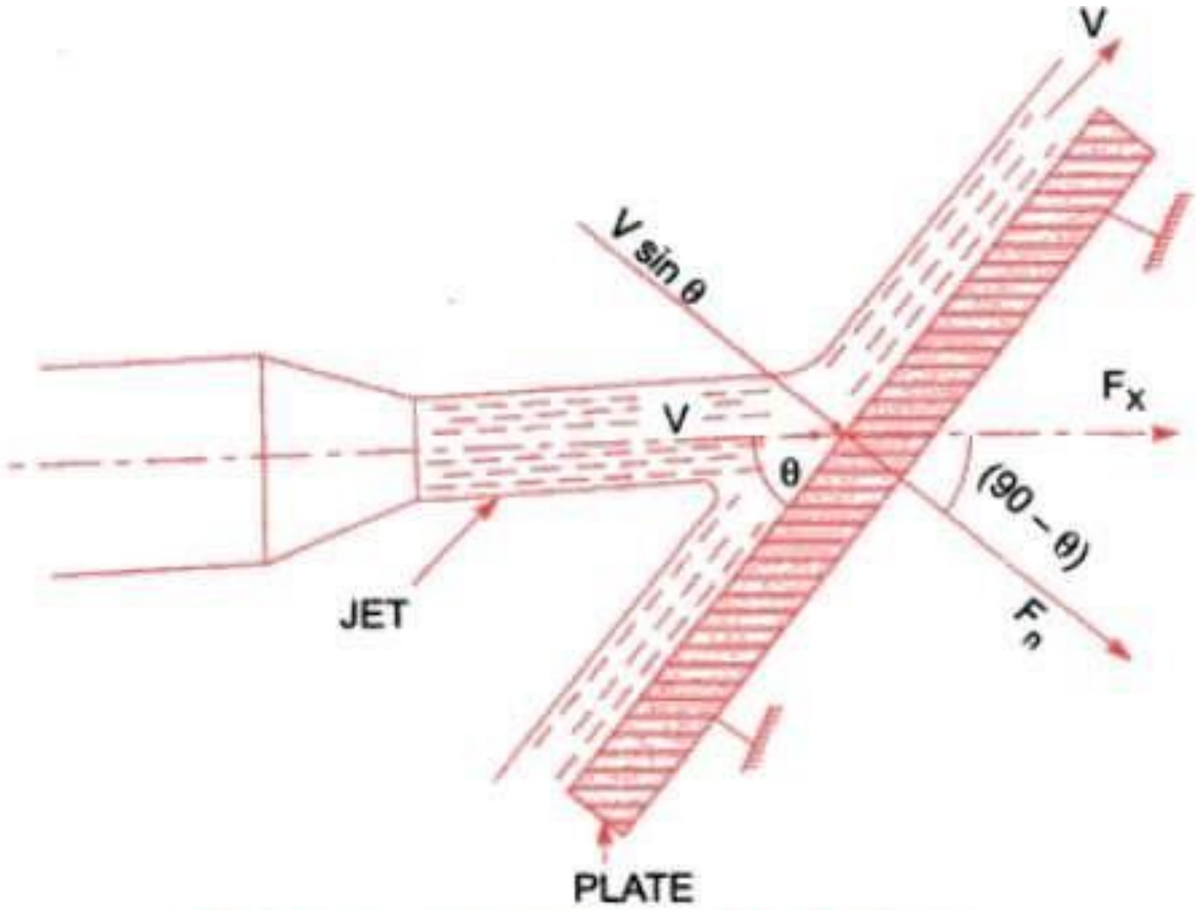
Force exerted by the jet on a stationary plate

Plate is inclined to the jet

$$F_N = \rho a V^2 \sin\theta$$

$$F_x = F_N \sin\theta$$

$$F_x = F_N \cos\theta$$



Jet striking stationary inclined plate.

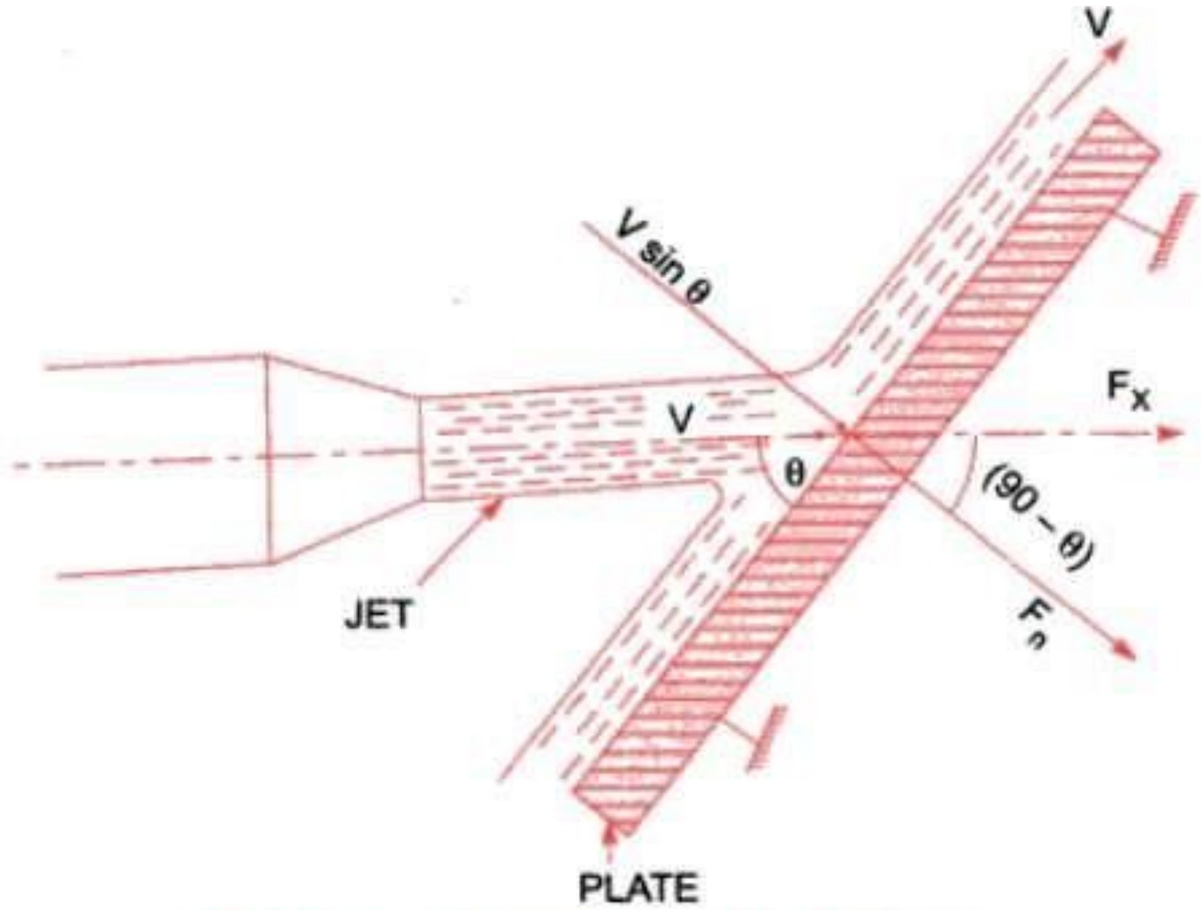
Force exerted by the jet on a moving plate

Plate is inclined to the jet

$$F_N = \rho a(V-U)^2 \sin\theta$$

$$F_x = F_N \sin\theta$$

$$F_x = F_N \cos\theta$$



Jet striking stationary inclined plate.

Force exerted by the jet on a stationary plate

Plate is Curved and Jet strikes at Centre

$$F = \rho a V^2 (1 + \cos\theta)$$

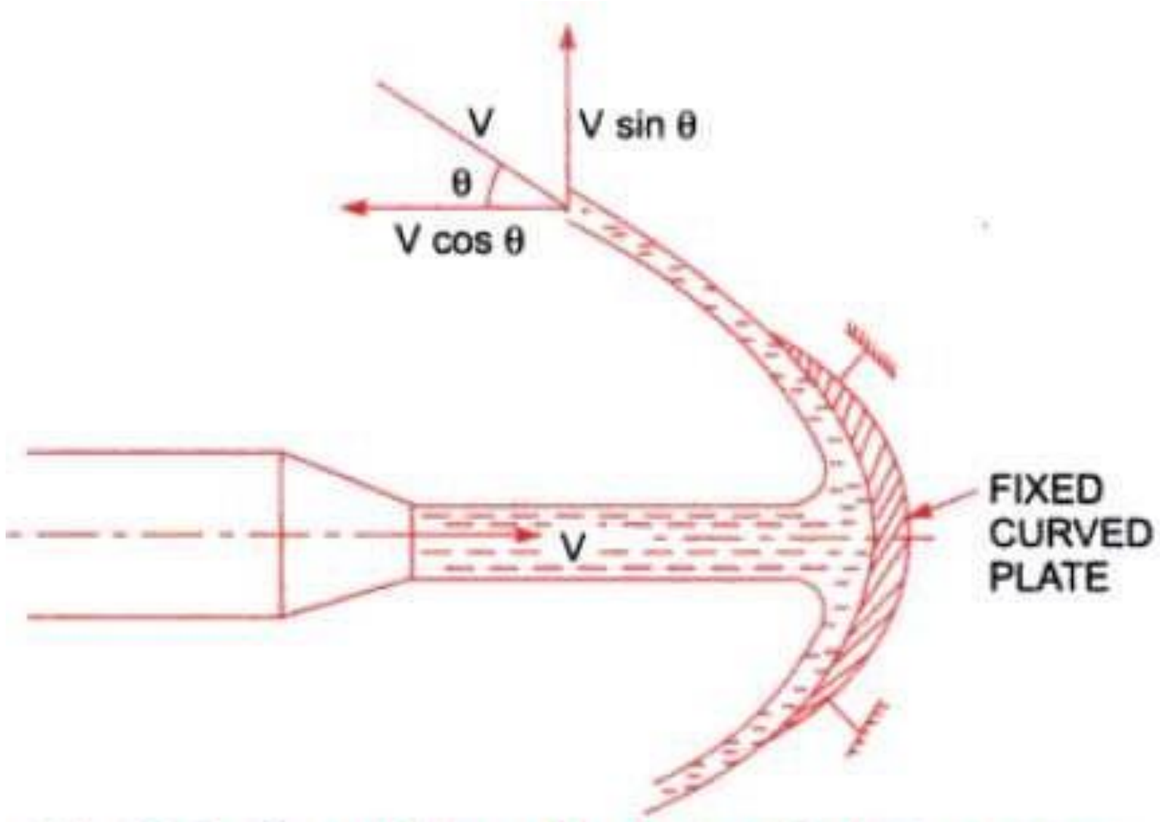
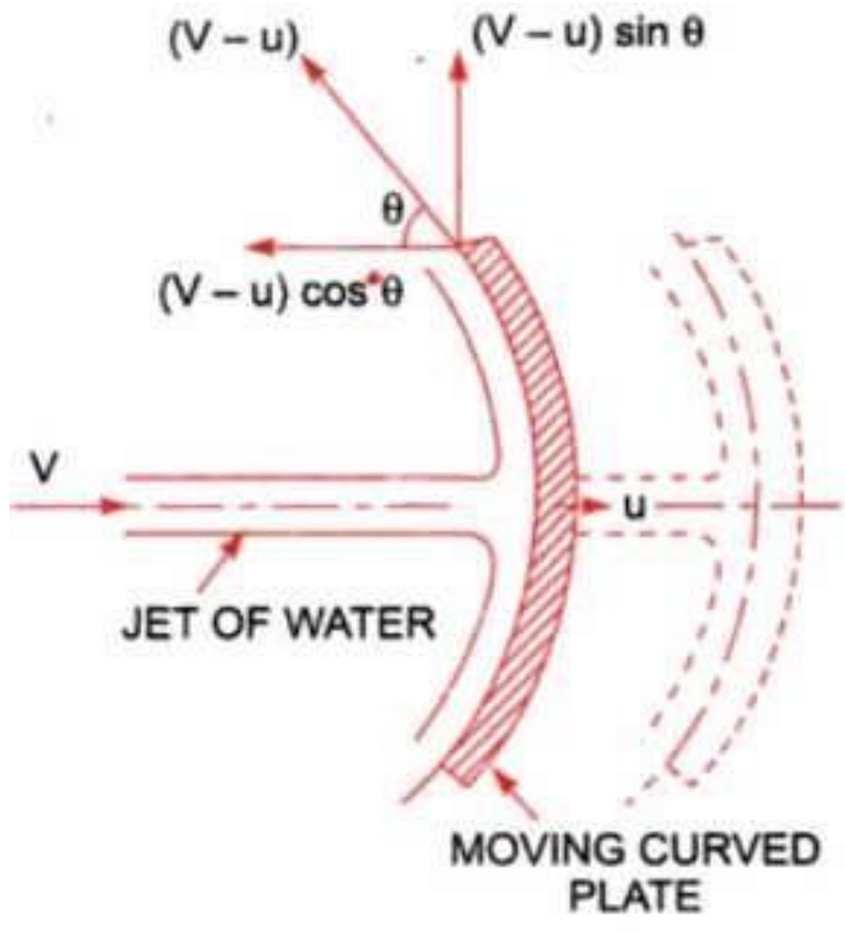


Fig. 17.3 *Jet striking a fixed curved plate at centre.*

Force exerted by the jet on a moving plate

Plate is Curved and Jet strikes at Centre

$$F = \rho a(V-U)^2 (1+ \cos \theta)$$



Force exerted by the jet on a stationary plate (Symmetrical Plate)

Plate is Curved and Jet strikes at tip

$$F_x = 2\rho a V^2 \cos\theta$$

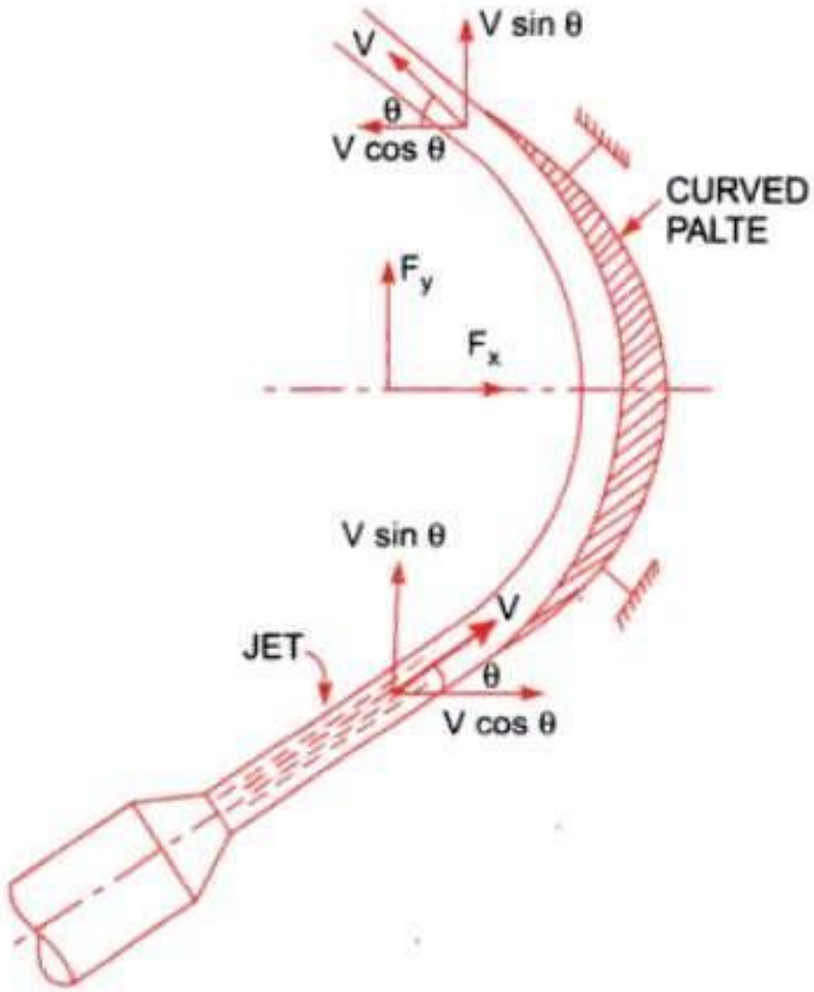
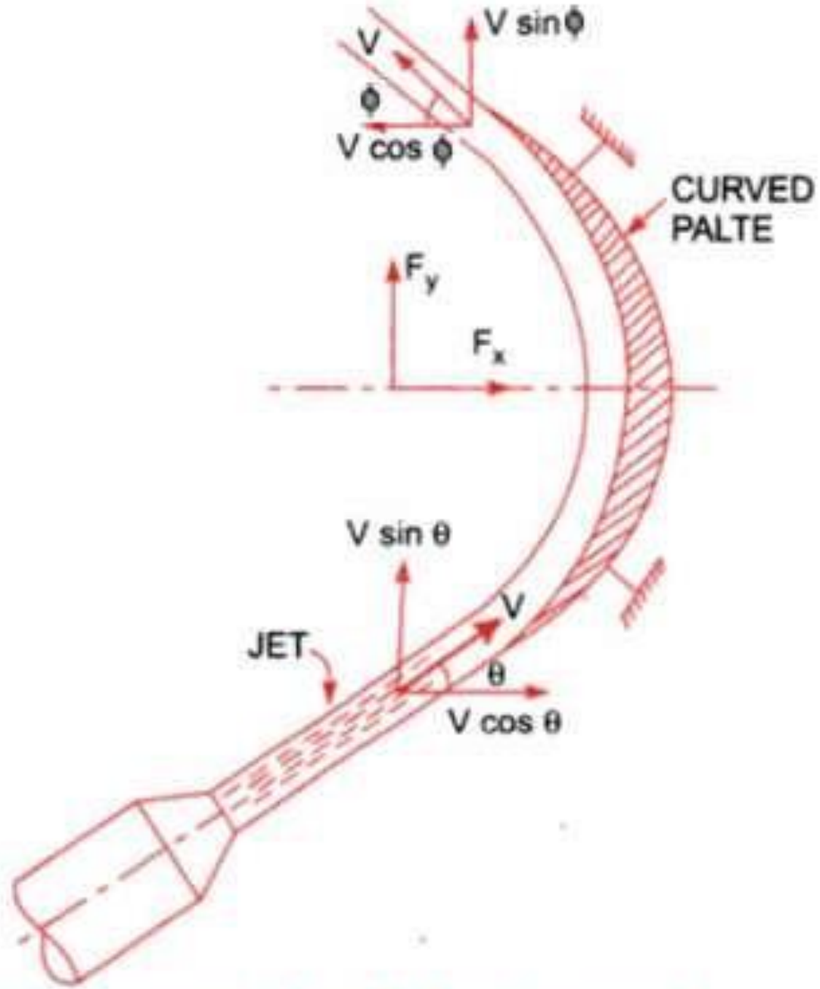


Fig. 17.4 *Jet striking curved fixed plate at one end.*

Force exerted by the jet on a stationary plate (Unsymmetrical Plate)

Plate is Curved and Jet strikes at tip

$$F_x = \rho a V^2 (\cos\theta + \cos\phi)$$



Jet striking curved fixed plate at one end.

Force exerted by the jet on a moving plate

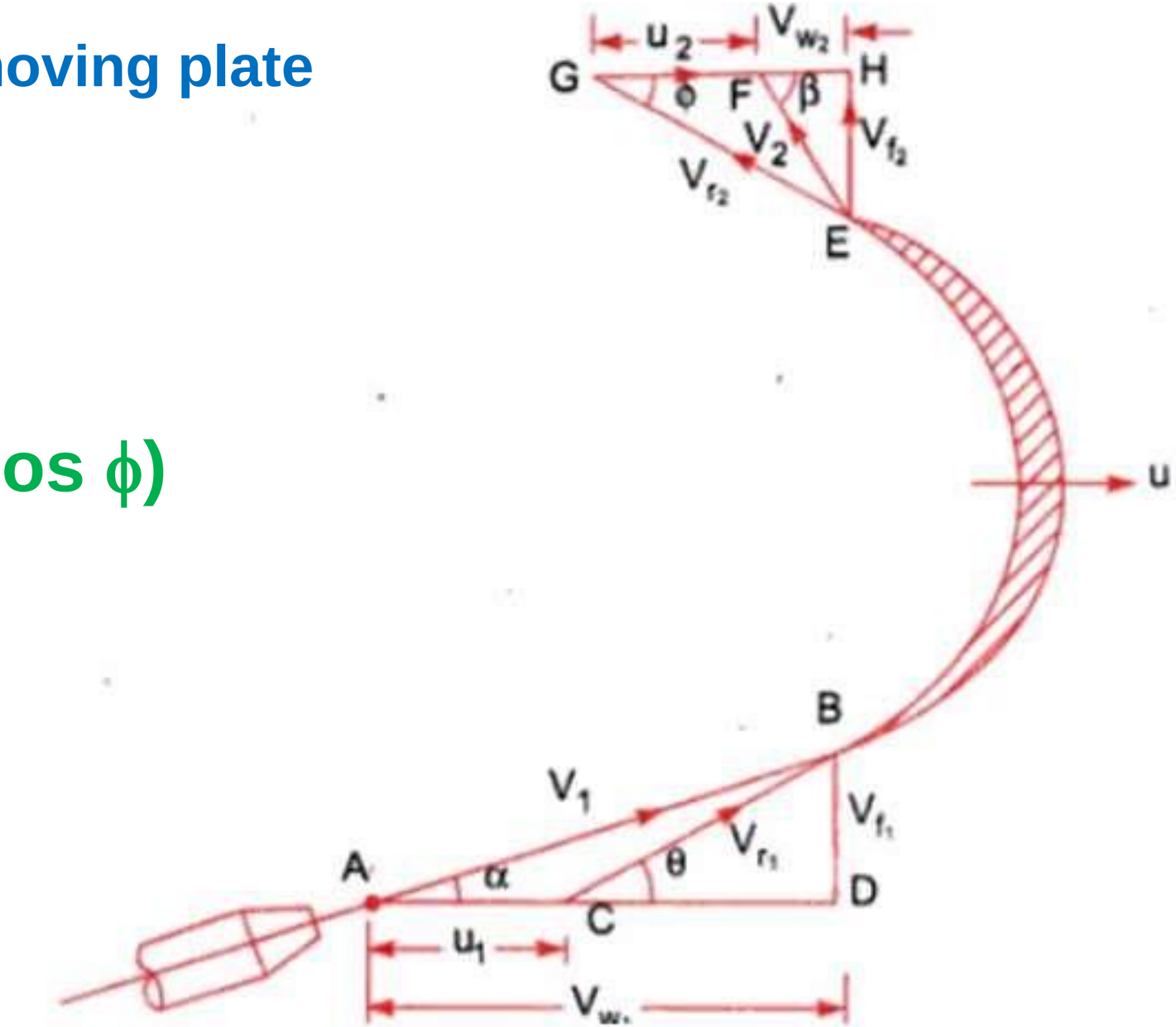
Considering Relative Velocity,

If $\beta < 90^0$

$$F_x = \rho a V_{r1} (V_{r1} \cos\theta + V_{r2} \cos\phi)$$

OR

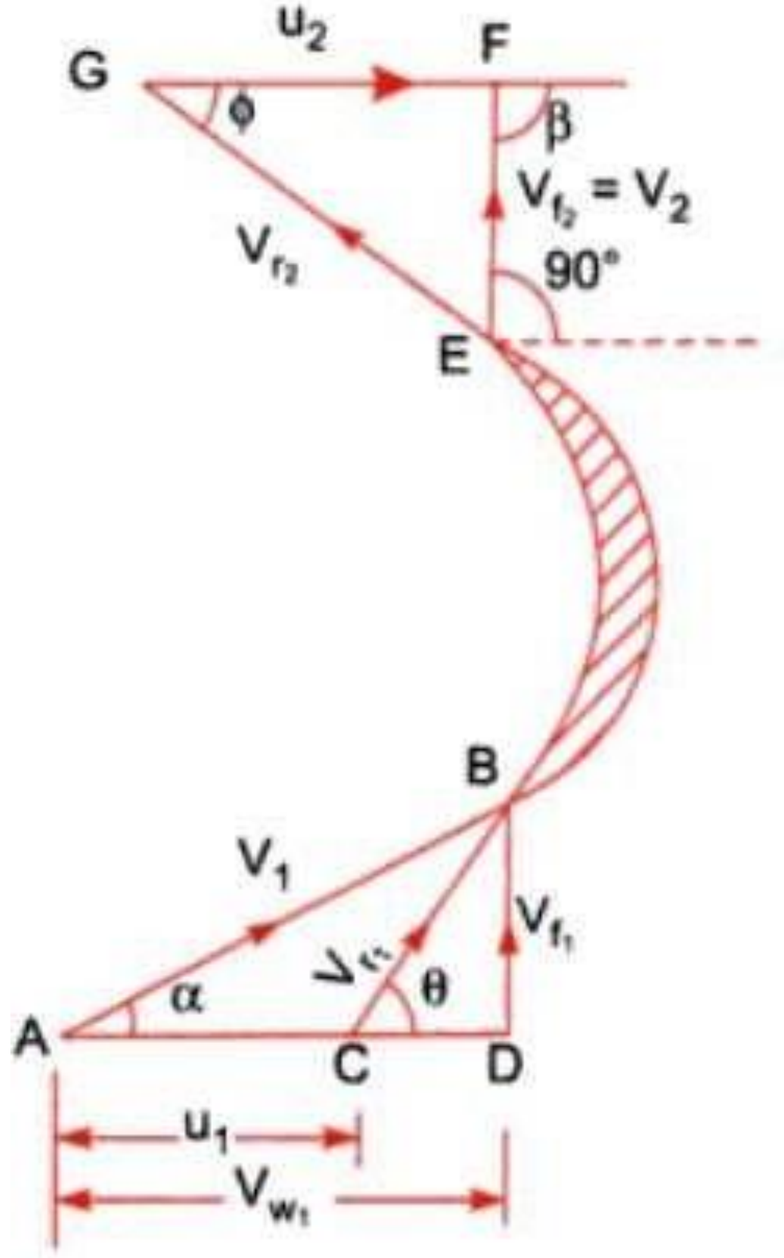
$$F_x = \rho a V_{r1} (V_{W1} + V_{W2})$$



Jet striking a moving curved vane at one of the tips.

Force exerted by the jet on a moving plate

Considering Relative Velocity,



If $\beta = 90^0$

$$F_x = \rho a V_{r1} (V_{r1} \cos \theta - V_{r2} \cos \phi)$$

OR

$$F_x = \rho a V_{r1} (V_{W1})$$

Force exerted by the jet on a moving plate

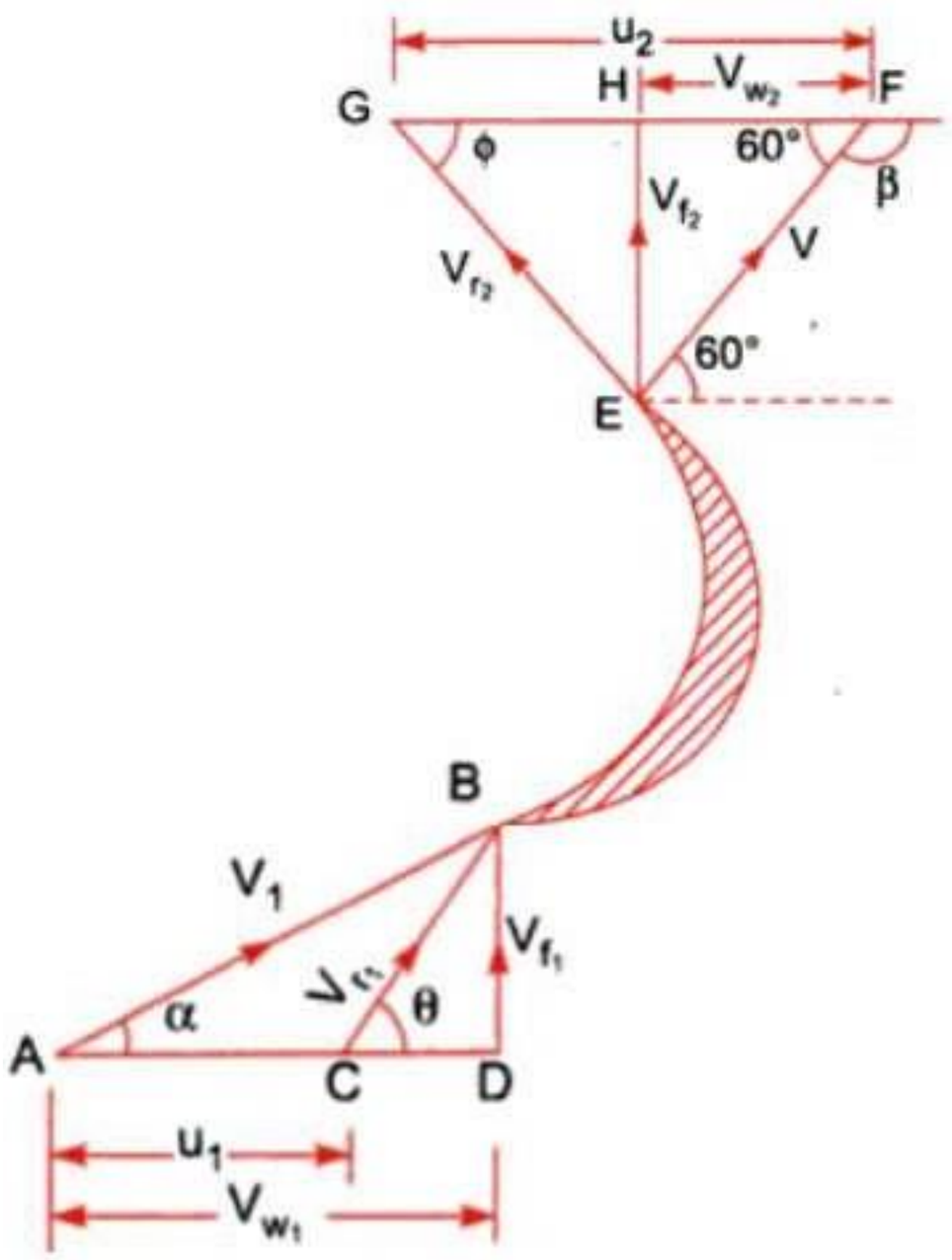
Considering Relative Velocity,

If $\beta = 90^0$

$$F_x = \rho a V_{r1} (V_{r1} \cos\theta - V_{r2} \cos\phi)$$

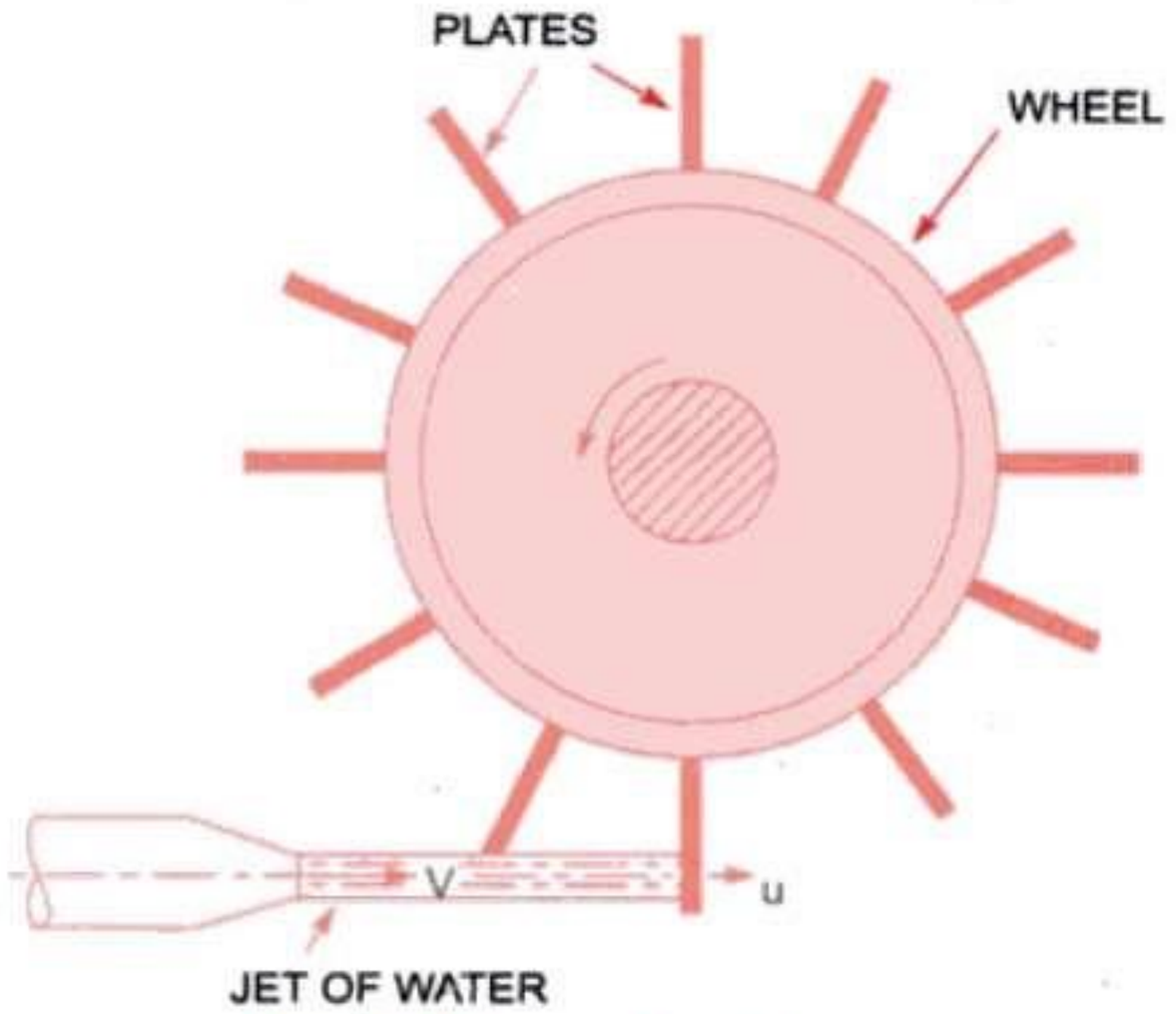
OR

$$F_x = \rho a V_{r1} (V_{W1} - V_{W2})$$



Impact of jet on a series of flat vanes mounted radially on the periphery of a circular wheel

$$F = \rho a V (V - U)$$



Jet striking a series of vanes.

JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Thank you!

STAY HOME, STAY SAFE