



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Water Harvesting and Soil conservation Structures

Presented By-

Shubham Kumar Sarangi

Asst Professor

**DEPARTMENT OF AGRICULTURAL ENGINEERING, SoABE
CENTURION UNIVERSITY OF TECHNOLOGY AND
MANAGEMENT PARALAKHEMUNDI, ODISHA**

Hydraulic Jump

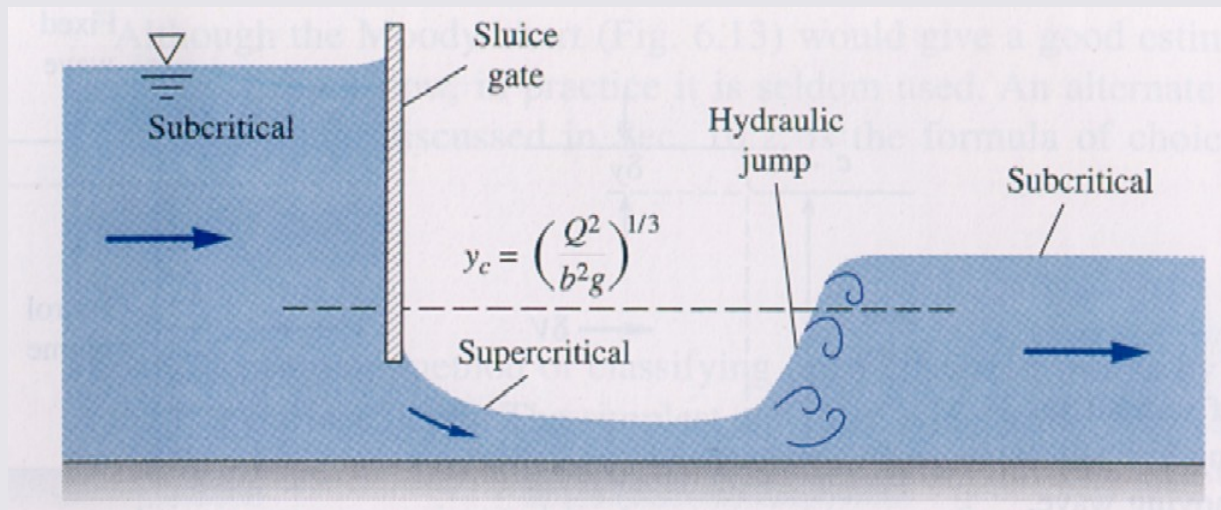


Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

Hydraulic jump defined as, it is the rise of water level, which takes place due to the transformation of unstable shooting flow (super-critical) to the stable streaming flow (sub-critical flow).

- It frequently occurs in a canal below a regulating sluice, at the toe of a spillway.
- Generally the width of sub-critical is larger than the super-critical.





Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Critical depth:

- Critical depth of an open channel is the minimum depth of water above ground level at which the velocity of flow is very high and flow takes place with more of turbulence.
- The velocity of water at this depth is called as critical velocity.

Supercritical depth:

- Super critical depth is the depth of water which is smaller than critical depth and it represents very hard and super-critical situation for basic flows taking place in dams, weirs and many irrigation structures.
- The velocity of water at this depth is greater than the critical velocity. Flow in this region is called supercritical.



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

Subcritical depth:

- Subcritical depth is the depth greater than critical depth.
- The velocity of water at this depth is smaller than the critical velocity. Flow in this region is called subcritical flow.

Basic Characteristics of Hydraulic Jump:

- The jump is unsteady, irregular
- Based on wind directions and heavy wind blow, it changes its property and can be choppy and undular sometimes.



Types of Hydraulic Jumps

- **Based on Froude's Number:**
- Basically a hydraulic jump occurs in many types depending on topographical features and bed surface roughness and many other natural interface relations.
- This hydraulic jump types can be probably expressed based on Froude's number:

1 .Undular Hydraulic Jump – Froude Number (1 to 1.7):

- Undular Jump is irregular, not properly formed and there are certain turbulences in water particles.



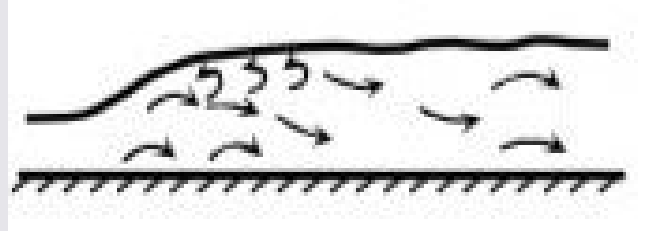


Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

2. Weak Jump – Froude Number (1.7 to 2.5)

Weak jump takes place when the velocity in water is very less and the water particles cannot be stable and flows in various ways.



3. Oscillating Hydraulic Jump – Froude Number (2.5 to 4.5)

Oscillating jump forms when an oscillating jet enter into super critical state and there the number of particles starts oscillating in clockwise or either anticlockwise direction, forming slighter tide



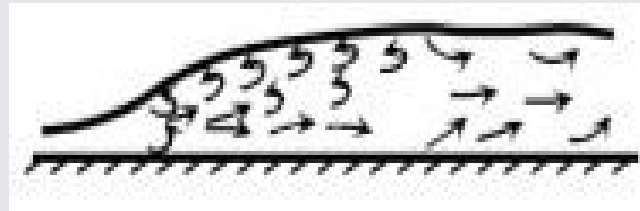


Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

4. Steady Hydraulic Jump – Froude Number (4.5 to 9)

In steady jump, the bed surface is quite rough so the particles start to tend in one direction with heavy velocity and turbulence, frictional losses are more in this type of jump.



5. Strong Hydraulic Jump – Froude Number (greater than 9)

- Strong jump is a perfect jump formed when frictional losses are more, air pressure division is equal and velocity is very high that losses take place.
- The water changes its state from super critical to subcritical in very shorter length when compared to all other types of hydraulic jumps.



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

- so this jump is highly preferred in dam structures.



Application:-

- hydraulic jump reverses the flow of water. This phenomenon can be used to mix chemicals for water purification
- It is used for irrigation purposes
- It is used to remove the air from water supply and sewage lines to prevent the air locking



Centurion
UNIVERSITY

*Shaping Lives...
Empowering Communities...*

- It is used for efficient operation flow of measurement flumes.
- Desalination of seawater.
- It is also used for discharge measuring device
- Minimizes Erosion & Scouring due to high velocities.