STUDY ON HYDRAULIC JUMP A REVIEW

MANOJ NALLANATHE1, RAMESH.BHASKAR2, VISHNU KUMAR REDDY3.

1,2. Faculty Of Civil Department, Saveetha school of Engineering, Saveetha university, Chennai
3. UG scholar, Civil Department, Saveetha School Of Engineering, Saveetha University, Chennai.
jonamcivil@gmail.com1, 2.ramesh.bhaskar@gmail.com, bvsvishnukumar1234@gmail.com3

Abstract:

We are doing different types of hydraulic jump & slopes in every hydraulic jump. Whenever, flow changes the positions will be supercritical is (fr>1) to subcritical is (fr<1). The Froude number has dimensionless number defined as ratio flow inertia to the external field. In the venturi flume constricted flow it causes drop in hydraulic grade line and creating a critical depth.

Key words: different slope, discharge, rough surface, narrow crest, broad crest, ogee fall, rectangular channel.

Introduction:

Hydraulic jump in open channels can be attributed to rapidly varied flow where a significant change in velocity occurs from super-critical flow to sub-critical flow. This fact may owe to the presence of some structures obstructing the movement of flow in open channels. Under-shot weir or gate is the most impressive example for hydraulic jump formation in canals where the flow undergoes high velocity under gates with upstream small depth and returns back to a higher downstream conjugate depth away from the gate with lower velocity and we find the discharge of it.

discharge formulae:

\[ Q_t = \frac{v}{T} \]  \---------(1)

Discharge for unit length:

\[ q = Q/h \]  \---------(2)

The hydraulic jump has many practical and useful applications. Among them are the following:
• Reduction of the energy and velocity downstream of a dam or chute in order to minimize and control erosion of the channel bed.
• Raising of the downstream water level in irrigation channels.

Therefore, before going to the hydraulic jump, we have to refer to the specific energy.

**Types of flow:**

There are three types

- Tranquil flow
- Critical flow
- Rapid flow

**Tranquil flow:** The depth of water in the channel is greater than the critical depth, the flow is called tranquil flow (or) sub-critical.

**Critical flow:** if the depth of water in the channel is critical the flow is called critical.

**Critical depth of the channel:**

\[ h_c = \left( \frac{q^2}{g} \right)^{0.33} \]  

\[ V_c = \frac{q}{h_c} \]

**Rapid flow:** if the depth of water in the channel is smaller than the critical depth, the flow is called rapid flow (or) super-critical.

---

**Froude number & Types of Jumps:**

Froude no is 1-3 then jump type is undular and description is to be the water surface shows undulations.

Froude no is 3-6 then jump type is weak and description is to be a series of smaller roller develop on the surface of the jump, but the downstream water surface remains smooth. It energy loss is too low.

Froude no is 6-20 then jump type is oscillating and description is to be there is an oscillating jet entering the jump from bottom to surface and back again with no periodicity. Each oscillation produces a large wave of irregular period which, very commonly in canals, can travel for meters doing unlimited damage to earthen banks and rip-raps.
Froude number:

\[ F1 = \frac{g h1^2}{2} \] 
\[ F2 = \frac{g h2^2}{2} \] 
\[ F = 9.81 \times 10^4 q / 9.81 v^2 - v_1 \]

Energy loss due to the hydraulic jump:

In this experiment, the energy is no initial loss of energy when flow jump is from supercritical to subcritical depth.

\[ \Delta E = E1 - E2 = (h1 + v_1^2 / 2g) - (h2 + v_2^2 / 2g) \]

Dissipation of power in hydraulic jump:

Dissipation of an energy loss of flow over dam, weir and other structures will be the flow of energy loss or gain.

\[ \Delta p = pgQ(E1 - E2) \]

LITERATURE REVIEW ON FLUME:

1. Mostafa MEI-Seddik, Hydraulic jump experiment in a rectangular open channel flume, Froude number is associated with the change of water depth and discharge will open channels.
2. ASFIA SULTANA, A STUDY OF HYDRAULIC JUMP IN A SLOPING CHANNEL WITH ABRUPT DROP, this abrupt change in flow condition is accompanied by considerable turbulence and loss of energy. To develop a theoretical model to determine the sequent depth in sloping channel with drop.
3. Andrea Defina, Francesca Maria Susin, and Daniele Pietro Viero, Bed friction effects on the stability of a stationary hydraulic jump in a rectangular upward sloping channel, An upward sloping ramp 4.20 m long and 0.38 m wide with a well-rounded leading edge was placed at the flume entrance.
4. Edward J. Hickin, the momentum equation for open-channel flow, Hydraulic jumps mark the flow transition from supercritical to subcritical flow. When subcritical flow accelerates into the supercritical state the transition often is smooth with gradually increasing velocity and decreasing depth bringing about a smooth drop in the water surface until the alternate depth is achieved.
5. Youngkyu Kim, Hyoseon Park (22 September 2015), Hydraulic Jump and Energy Dissipation with Sluice Gate. To control hydraulic jump and enhance hydraulic jump efficiency, sills such as sharp-crested weirs, broad-crested weirs or end sills at the bottoms of waterways are frequently used.
6. Ali Mohsen Hayder (Jordan Journal of Civil Engineering, Volume 11, No. 2, 2017), A Laboratory Study on Stilling Basin with Semi-circular Rough Bed Elements. The objective of this research was to introduce and make a comparison of roughed bed hydraulic jump stilling basin by using semi-circular rough elements. Each rough element shape was tested under different Froude numbers, ranging from 4 to 11.

7. Samir Kateb, Mahmoud Debabeche, Ferhat Riguet, Hydraulic jump in a sloped trapezoidal channel, the hydraulic jump is used to dissipate the kinetic energy of a supercritical flow to avoid important modifications of the stilling basin bed. Nevertheless, the trapezoidal section does not satisfy the requirement of a stilling basin, but has some interesting practical applications when used as an irrigation ditch (Achour 1989). The capacity of the hydraulic jump to raise tail water depth is used to prime a hose siphon designed for the required discharge.

8. Justin M. Lennon, APPLICATION OF PARTICLE IMAGE VELOCIMETRY TO THE HYDRAULIC JUMP, The Froude number boundary has been determined experimentally to be about 1.7 for jumps that have fully developed supercritical inflow.

9. Marta Lopez Egea, Experimental and Numerical Modelling of Submerged Hydraulic Jumps at Low-Head Dams, this study, which includes both experimental and numerical-modelling components, investigates the potentially dangerous conditions that can often occur when low-head dams (or weirs) are overtopped and ‘submerged’-type hydraulic jumps subsequently form downstream of these hydraulic discharge structures.

10. Anniina Kittila, Weirs and flumes, these structures can be permanently built on site to have a possibility for continuous monitoring, or portable structures that can be separately installed for individual measurements. Flumes are open channels where the upstream sub-critical flow is constricted by narrowing the channel which causes an increase in velocity and a decrease in the depth of the flow. Weirs are dam-like overflow structures that can be characterized based on the edge or surface over which the water flows, called crest.

RESULT :-

<table>
<thead>
<tr>
<th>AUTHORS</th>
<th>DESCRIPTION</th>
<th>RESULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mostafa M El-Seddik</td>
<td>Hydraulic jump in open channels can be attributed to rapidly varied flow where a significant change in velocity occurs from super-critical flow to sub-critical flow</td>
<td>In this author he said about different for types of critical flow.</td>
</tr>
<tr>
<td>ASFIA</td>
<td>The slope varies dissipating</td>
<td>Water flow from one level to</td>
</tr>
</tbody>
</table>
CONCLUSION:

In this paper says about different types slope stability with there conditions like roughness, various types of weirs. The energy variation at different points. Hydraulic Jump Properties Over A Rough Bed

REFERENCES:

4. M.T. anam, Y.C.jin (In 2010)
5. Experimental study for sequent depth ratio
   of hydraulic jump in horizontal expanding channel.

CONCLUSION:

In this paper says about different types slope stability with there conditions like roughness, various types of weirs. The energy variation at different points. Hydraulic Jump Properties Over A Rough Bed

REFERENCES:

4. M.T. anam, Y.C.jin (In 2010)
5. Experimental study for sequent depth ratio
   of hydraulic jump in horizontal expanding channel.

CONCLUSION:

In this paper says about different types slope stability with there conditions like roughness, various types of weirs. The energy variation at different points. Hydraulic Jump Properties Over A Rough Bed

REFERENCES:

4. M.T. anam, Y.C.jin (In 2010)
5. Experimental study for sequent depth ratio
   of hydraulic jump in horizontal expanding channel.

CONCLUSION:

In this paper says about different types slope stability with there conditions like roughness, various types of weirs. The energy variation at different points. Hydraulic Jump Properties Over A Rough Bed

REFERENCES:

4. M.T. anam, Y.C.jin (In 2010)
5. Experimental study for sequent depth ratio
   of hydraulic jump in horizontal expanding channel.

CONCLUSION:

In this paper says about different types slope stability with there conditions like roughness, various types of weirs. The energy variation at different points. Hydraulic Jump Properties Over A Rough Bed

REFERENCES:

4. M.T. anam, Y.C.jin (In 2010)
5. Experimental study for sequent depth ratio
   of hydraulic jump in horizontal expanding channel.
upward sloping channel Andrea Defina, Francesca Maria Susin (Padova, Italy, 4 March 2008)

14. Hydraulic Jump and Energy Dissipation with Sluice Gate Youngkyu Kim, Hyoseon Park (22 September 2015)


16. An experimental study of the circular internal hydraulic jump. Iva Kavain (University of Zagreb, Croatia)
