Colliding Water

Flow Visualization ATLS 4151

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Context

Spoons. Most people have used one. A spoon held underneath a tap upside down while water flows onto it produces a dome-like shape as water collides and scatters. And when flipped something leaf-like. A lot of people The main ideas I toyed with were around potential collisions of this nature and the shapes it could have made depending on the shape of the surface it collided with. Collision based laminar flows under large water volumes would have been an interesting idea, however on the tragic account of not possessing any giant spoon-like items there wasn't an easy way that my intent could be realized. The group once gathered used a setup Grace proposed, a camping tarp and hose. The lumps and dips on a slight incline made a decent river simulation and spraying it down with a hose allowed a myriad of flows and visuals. For the majority of the time one of us was holding the hose and altering the exit shape or collision point, while others made adjustments to the tarp, changed the pressure or something else that potentially produced another flow.

The flow came from a stream from the hose colliding into a pool close to a ridge created from the tarp, this increased the volume and due to being pointed downhill the added volume followed the gap in the ridge in the "blade" pattern which made the main spout in the background, the added aeration forming the bubbles on the sides upon contact. The pieces of water with higher velocity going higher through the gap and those going slower not as much, the velocity gradient forming a sheet. The hose inserted water and was held above the pool at a decent distance. The water went about half a foot before crashing to the ground. The full calculation below revealed a reynolds number of 86000 marking the flow as rather turbulent. The assumption of a 17 gallons per minute flow from a garden hose, converted to get a velocity along 6 inches of length and divided by the kinematic velocity in feet^2/s

1

$$\frac{.5\,(b)}{0.000010098} = 85969.2881175$$

2

$$v = \frac{17}{7.48} = 2.27272727273$$

3

$$b = \frac{v}{(a)60} = 1.73623574282$$

4

$$a = \frac{\pi}{144} = 0.0218166156499$$

Both sources were used to get figures for the calculations. The small bubbles come seem to come from aeration as when tap water goes in a glass and small bubbles exist before popping these bubbles remain and go along the flow due to surface tension.

The photo was taken in sunshine from the shade facing downhill, there was no additional light. There was no change in white balance and the shutter speed was 1/2513. The focal length was f/2.8 and the iso was 1164. These changes were mainly done to capture an instant of collision there wasn't any particular reason for each of the changes beyond experimentation and seeing what worked and what didn't and hoping to stumble into a good visual.

The image shows an instantaneous still of water as it is colliding and moving but there isn't really any scientific foundation to it, if it were to be redone I would like to measure it exactly and test flows on it a few times to see how far it may be taken under exact conditions. A slow motion video would work rather well for showing more flow and in the same detail but there isn’t much else to be said for it. This was mainly done for the visuals first and the science bits second.

https://www.dripworks.com/blog/garden-hose-flow-rates

https://www.engineeringtoolbox.com/water-dynamic-kinematic-viscosity-d_596.html