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MCEN 5151

Team Third

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Introduction

For my team third image, I wanted to really try and show the growth I've made in my photography skills in this class over the course of the semester. In particular, I did not want to make a fancy setup and instead do what I will be doing after this class, finding natural elements and phenomena to photograph. This picture was not the original phenomena I was trying to capture and instead tried to capture ocean waves. The waves were not strong enough to produce a great photograph so instead I decided to take a picture of this waterfall. This picture was taken with the help of my dad, Rajesh Jain.

Flow Dynamics

The flow phenomena captured in this image is laminar flow and capillary flow. Laminar flow is described using the Reynolds number, which is a dimensionless parameter that describes laminar and turbulent flow¹. The equation is shown below in equation 1.

$$Re = \frac{uL}{\nu} \quad (1)$$

Re represents the Reynolds number, u represents the fluid velocity, L is the characteristic length, and ν is the kinematic viscosity of the fluid. By using this equation, the assumption that flow is laminar can be proven mathematically. By estimating the fluid velocity is about 0.1 m/s, an estimated characteristic length of $L = 0.01$ m, which is low due to the leading edge of the fall, and the kinematic viscosity of water at 33°C, which is average leisure pool temperature, of $\nu = 7.532 \times 10^{-7} \text{ m}^2/\text{s}^2$. This gives a Reynolds number of 1327.67. Since this number is less than 2300, the flow is laminar³.

In the foreground of the image, some capillary action can be seen as well, with the water forming into “capsules” as it falls. This was caused by the diversion of water from the sandal into the stream, which disrupts the flow slightly and results in the capillary action seen. Capillary action is caused when the adhesive forces are larger than cohesive forces. This attraction causes the leading water molecules to pull other neighboring water molecules along behind them⁴.

¹ Gerhart, Philip M., et al. Munson, Young, and Okiishi's Fundamentals of Fluid Mechanics. 8th ed., John Wiley & Sons, Inc. 2016.

² Chin Ngo, Chean, Gramoll, Kurt, Fluid Mechanics Theory. Multimedia Engineering Fluids

³ Ibid, 1

⁴ Rattle, Simon, et al. “Lab-on-a-Chip, Micro- and Nanoscale Immunoassay Systems, and Microarrays.” The Immunoassay Handbook, 2013, pp. 175–202., doi:10.1016/b978-0-08-097037-0.00013-0.

Photographic Setup

This picture was captured in a pool. The water from the pool slowly flowed over the edge of a small “cliff” and into another pool. In order to capture the image at the angle I did, my dad had to divert some water flow using a sandal. Figure 1 shows the setup from my perspective.

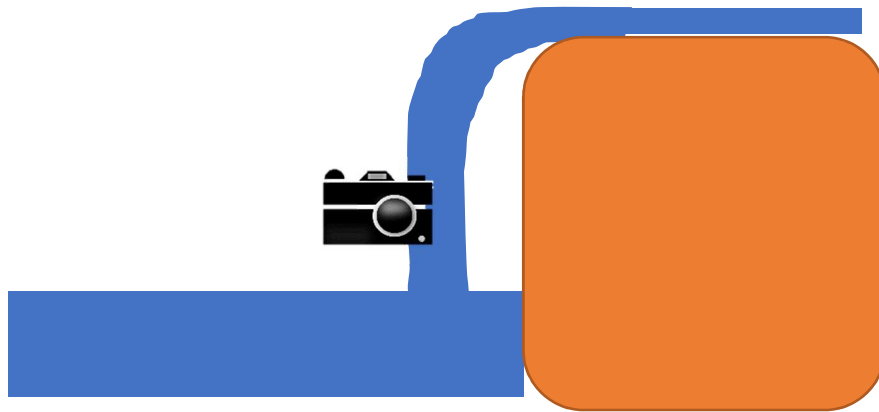


Figure 1: Head on schematic of how the picture was captured, the blue denotes water and the orange denotes land

The picture was taken outside using natural light from the sun, which when hitting earth’s surface is approximately equal to 1000 Watts per meter squared⁵. The picture was taken close to midday and therefore, the sun was almost directly above, at a slight southern angle.

Camera Settings

This picture was captured on a Samsung Galaxy S9. The dimensions of the original, unedited picture was 3024 x 4032. The shutter speed was 1/921 sec, which was chosen in order to negate motion blur. The f number was 1.7 with a focal length of 4 mm. The iso setting was 64. The picture was taken a few inches from the water movement and the field of vies is about 6 feet by 1 foot. The original photo can be seen below in Figure 2. Some post editing was done compared to the original picture, most notably the pool chairs in the background were taken out as these were distracting elements in the picture. I did not manipulate the contrast as I believe the original image displays the details of the flow well.

⁵ “Solar and Sustainable Energy.” The Sun's Energy, ag.tennessee.edu/solar/Pages/What%20Is%20Solar%20Energy/Sun's%20Energy.aspx#targetText=At%20the%20upper%20reaches%20of,level%20on%20a%20clear%20day.

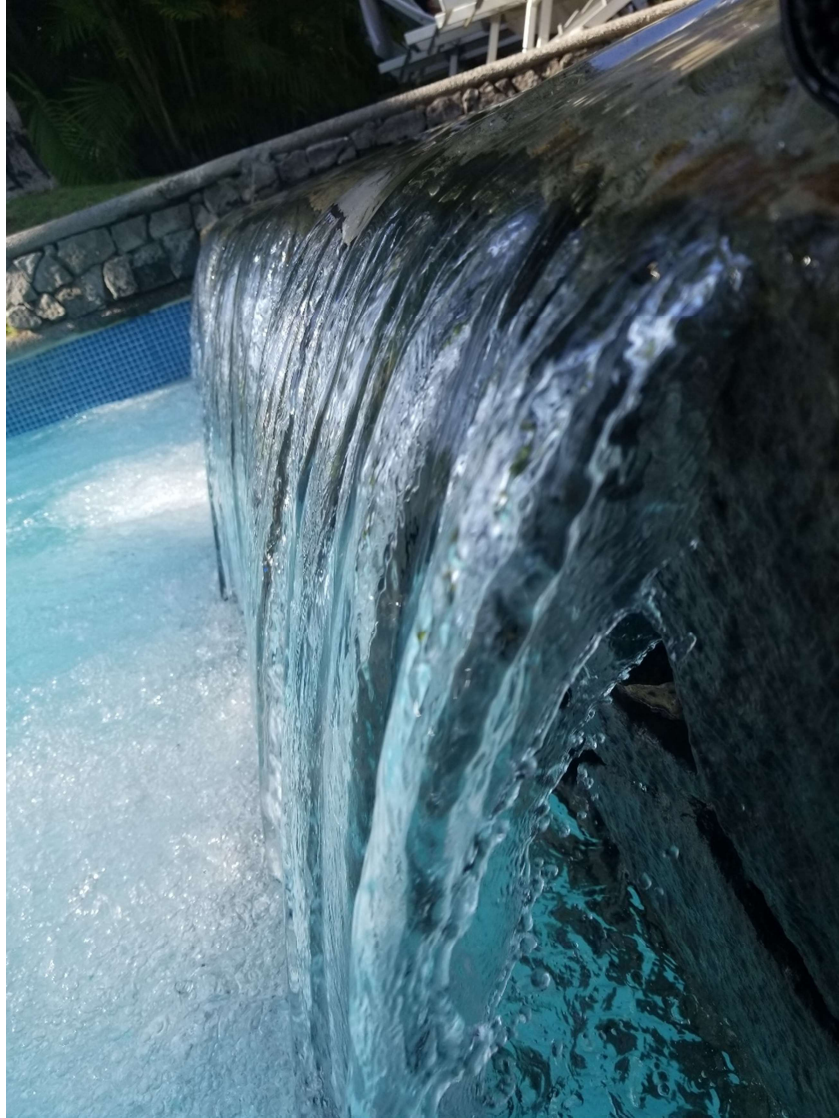


Figure 2: Original image

Conclusion

I am very pleased with this image and the photography skills I have learned throughout the semester. This class has taught me a lot of about the skills of photography and the settings on cameras that can be changed to make any image even better. It also allowed me the opportunity to learn how to use picture editing softwares like photoshop and gimp. With regards to this image, there isn't a single aspect I do not like. I am very proud of this image and of my growth in this class as an artist.