Sarah Pomerantz Research Plan

A. Rationale

Fluids, or liquids and gases, effect almost everything. This is especially paramount to mechanical engineers, as everything they build will be affected by the air surrounding it as well as any other fluids intentionally or unintentionally added to a system. So, when designing a new project it is important for engineers to understand how fluids will interact with it, however there are constraints to this. One can test an idea, including a fluid flow, in three ways: experimentally, analytically, or computationally. While experiments involving fluids can be expensive and the mathematics for an analytical approach can be far too time consumer, computers are able to simulate fluid flows quickly and accurately. Computer software can be a key element in ensuring a structure interacts with fluids in a positive manner. They can also be used to form a basis of understanding for further works.

B. Research Questions, Hypotheses, Engineering Goals, Expected Outcomes

1. Question

Using computational fluid mechanics, how will a fluid with a reynolds number of 80 flow past various rigid structures?

2. Hypotheses & Expectations

It is expected that a fluid flow past a cylinder will display a Von Karman Effect.

Flows past similar structures will display similar flow patterns.

C. Procedures

This experiment will be modeled using the Ansys Student Software. On this software, parameters will be set so the reynolds number of the fluid is 80. Rigid structures will be drawn in the middle of a fluid domain and a fine mesh will be created for the most accurate results. The structures investigated will be:

1. Cylinder
2. Horizontal Ovular Cylinder
3. Vertical Ovular Cylinder
4. Cube
5. Equilateral Triangular Prism facing Outlet
6. Equilateral Triangular Prism facing Inlet
7. Equilateral Triangular Prism facing Wall
8. Cube Rotated 90°
9. Right Scalene Triangular Prism

a. Risk and Safety

There will not be any safety risks in this research.

1. Human Participants: N/A
2. Vertebrate Animals: N/A
3. Potentially Hazardous Biological Agents: N/A
4. Hazardous Chemicals, Activities, & Devices: N/A

b. Data Analysis

After simulations are created using the above parameters the results will be collected and compared. The size and structures of the recirculation regions will

be compared as well as the structure of each Von Karman vortex street. The observations about these shapes can be applied to real life building problems.

D. Bibliography

[1] *ANSYS Student* [Computer Software]. (2019) Retrieved from https://www.ansys.com/academic/free-student-products

[2] Bisetti, F., Attili, A., & Pitsch, H. (2014). Advancing predictive models for particulate formation in turbulent flames via massively parallel direct numerical simulations. *Philosophical transactions. Series A, Mathematical, physical, and engineering sciences*, *372*(2022), 20130324. doi:10.1098/rsta.2013.0324

[3] Cohen, I. M. and Kundu, P. K. (2008). *Fluid Mechanics.* Academic Press, San Diego, 4 edition.

[4] Reynolds Number. (n.d.). Retrieved from https://www.grc.nasa.gov/www/BGH/reynolds.html

[5] Van Dyke, M. (1982). *An Album of Fluid Motion.*

[6] White, Frank M. (2017). *Fluid Mechanics*. McGraw-Hill Education.

NO ADDENDUMS EXIST