FIELD OF STUDY

Mechanical Engineering

THESIS TOPIC

Simulating and Minimizing Back and Bottom Wall

Sump Pump Vortices

EXAMINING COMMITTEE

Dr. Jie Cui (Chairperson, Mechanical Engineering)

Dr. John Peddieson (Mechanical Engineering)

Dr. Glenn Cunningham (Mechanical Engineering)

ABSTRACT

This study was performed in an attempt to simulate vortices formed in a sump pumping application using the Computational Fluid Dynamics (CFD) package ANSYS Fluent. The simulation was based on previously obtained experimental results where vortices were visually observed and assigned a numerical magnitude. The results of the previous experimental study show constant vortex formation on the back wall and bottom face of the fluid domain and intermittent formation on the free surface. The back wall and bottom face vortices were used as validation cases for this simulation with the free surface results being given for reference.

A baseline simulation was performed to match experimental results and to be used to compare against parametric studies. The parametric studies performed were to analyze the effects of moving the sump pump pipe horizontally and vertically in the fluid domain, and to analyze the effects of changing the pipe bell geometry. After the parametric studies were performed, an optimized location simulation was performed in which the location of the pipe bell was changed based on the results of the parametric study to determine an area in the fluid domain where the back and bottom vortex formation would be minimized.

From the simulations performed the vortex formation was dependent on the location of the pipe bell but did not appear to have a dependency on the pipe bell radius as originally hypothesized. Additionally, the results of the optimized location study showed minimized vortex activity with respect to the baseline simulation on the back wall and bottom faces of the fluid domain as well as within the pump intake.

BIOGRAPHICAL SKETCH

Jesse East was awarded a Bachelor of Science Degree in Mechanical Engineering in May 2011 from Tennessee Technological University and began working at Flowserve; a fluid control company specializing in pumps, valves, and mechanical seals. In August 2012, he enrolled once again at Tennessee Tech to begin working on his Master's in Mechanical Engineering with a focus on fluids and Computational Fluid Dynamics (CFD) and graduated in May 2017 from the Master's program.

EDUCATION

M.S., Mechanical Engineering,

Tennessee Technological University, Spring 2017

B.S., Mechanical Engineering,

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College of Engineering

TENNESSEE TECH

The Department of

Mechanical Engineering

Announces the Thesis Defense

Of

Jesse East

In Partial Fulfillment of the Requirements

For the degree of

Master of Science

March 31st, 2017 at 10:00am

Held at

BRWN 236

Tennessee Tech University, Cookeville