

COMPUTER SIMULATION IN DESIGNING WATER PUMPS

V.V. Fisher, *student, group DM-51*

Computer simulation is helping engineers at Engineered Machined Products, Inc (EMP) of Escanaba, to design more efficient diesel engine water pumps. Using computational fluid dynamics (CFD), they can quickly evaluate the performance of preliminary designs. In particular, potential problems such as cavitation can be avoided early in the design. Cavitation causes noise, vibration and the potential to damage pump components.

EMP engineers use a sophisticated in-house one-dimensional solver to calculate initial 3D design based on the pump's required performance. Since this 1D solver does not take three-dimensional fluid dynamics into account, it cannot detect cavitation and physical pump testing must validate performance. Before creating a rapid prototype of the pump, engineers use CFD to simulate the design in three dimensions.

The simulation provides a much more thorough performance evaluation as well as crucial diagnostic information that helps the engineer quickly optimize the design. As a result, the company is able to rapidly create innovative designs such as its patented fully controllable water pump. The new design uses a proprietary mixed-flow impeller and diffuser leading to a very efficient design that improves the performance of the pump and can eliminate the mechanical seals that currently account for approximately 95% of all pump warranty claims.

Engineers input their customer's pressure, flow and rotational speed requirements along with secondary inputs that place some constraints on the pump geometry. The model then generates the complete 3D geometry for the pump design based on these parameters in a matter of seconds. While the one-dimensional solver provides dramatic advantages in its ability to quickly generate a preliminary design, it is limited because it cannot predict potential performance problems such as flow recirculation caused by the separation of the boundary layer from one of the surfaces of the pump. These three-dimensional effects cause losses in total pressure that will reduce efficiency and output.

EMP engineers use the CFX suite of software from ANSYS Inc of Canonsburg, PA, to verify and analyse the initial design for any potential problems. CFX software enables the engineers to model the full 3D

geometry of the pump and perform a CFD simulation that calculates flow velocities and pressures throughout the pump. The complete information provided by the simulation easily detects design issues that might reduce the performance of the pump and, just as important, pinpoints their location and cause so that engineers can easily solve the problem. For example, the simulation might show that the flow is separating from one of the surfaces of the pump. The engineers can adjust the geometry to correct the problem and verify the new design with another simulation. Without the CFD analysis, while the rapid prototype may have determined that something was harming efficiency, engineers would have to resort to trial and error to solve the problem. Many more design iterations would be required, each delaying the product introduction and causing thousands of dollars in engineering and prototyping costs.

The results of the analyses provide information that is used to continually develop the proprietary design software, which reduces future design iterations. A good example of many innovative designs that EMP engineers have created using these methods is an innovative pump designed to meet the requirements of today's engines. A highly efficient flow-through diffuser is used, which results in a flexible design that can be easily adapted to existing engines by allowing for various mounting locations. The new pump can improve efficiency by over 20%, decrease weight by a factor of 2.5 and cut envelope requirements by 50%. CFX helps develop innovative pumps that provide superior performance in far less time than was required in the past.

D.O. Marchenko, *EL Adviser*

MONETARY EVOLUTION

L. Saban, *student F-54*

Finance is the science of funds management. The general areas of finance are business finance, personal finance, and public finance. Finance includes saving money and often includes lending money. The field of finance deals with the concepts of time, money and risk and how they are interrelated. It also deals with how money is spent and budgeted.

Finance works most basically through individuals and business organizations depositing money in a bank. Banks are the main facilitators of funding through the provision of credit, although private equity, mutual funds,