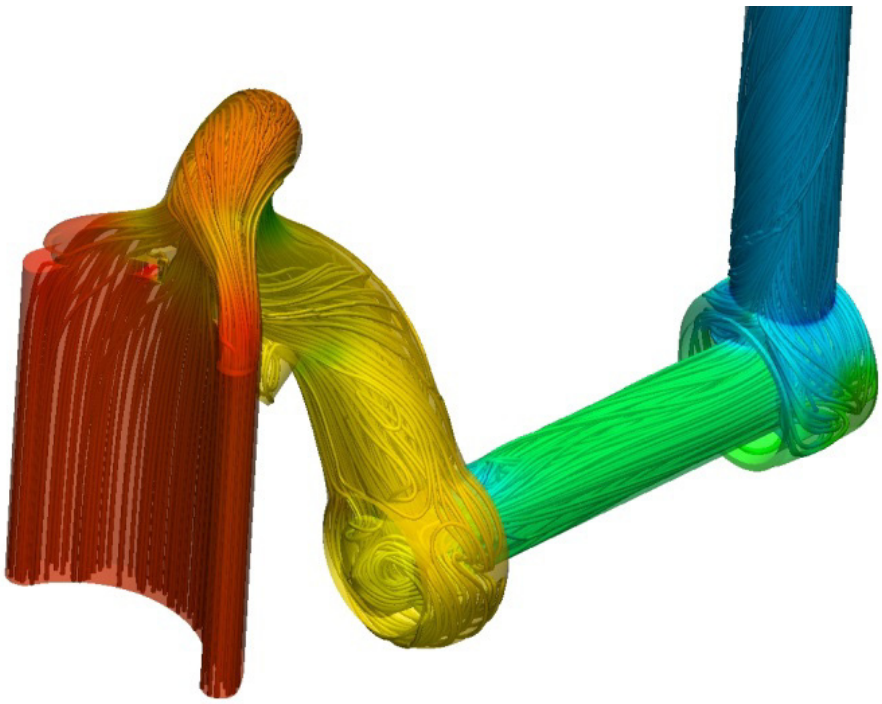
Variable Displacement Hydraulic Piston Pump/Motor: Pressure Drop Analysis

Analysis Type:
CFD, Pressure Drop, Steady State, Incompressible Flow

Discipline:
CFD, CFdesign, AutoDesk Simulation CFD, Computational Fluid Dynamics, Fluid Mechanics



Project Overview

Variable flow hydraulic motors have been around for years but are finding new applications in the development of infinitivally variable drive systems for super energy efficient vehicles.

The variable displacement piston pump (also known as an axial piston pump or a bent-axis piston pump) is used to convert hydraulic flow in to mechanical energy (torque) and vice versa. This technique is commonly used in hydrostatic transmissions.

Our work developed optimized geometries for minimize pressure drop through the yoke while also ensuring acceptable stress levels within the casting. Since the device would be used in both pump mode (converting torque to flow) and motor mode (converting flow to torque) a CFD analysis was required for two sets of boundary conditions.

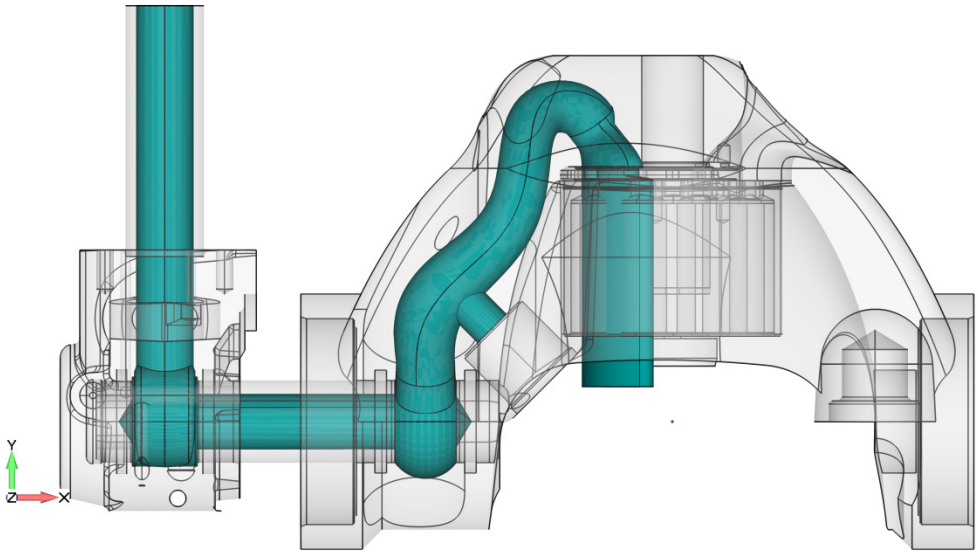


Figure 1: The CAD geometry of the piston pump is shown above. The CFD analysis focused on the internal fluid volume shown in green while the FEA focused on the cast structure shown in gray.

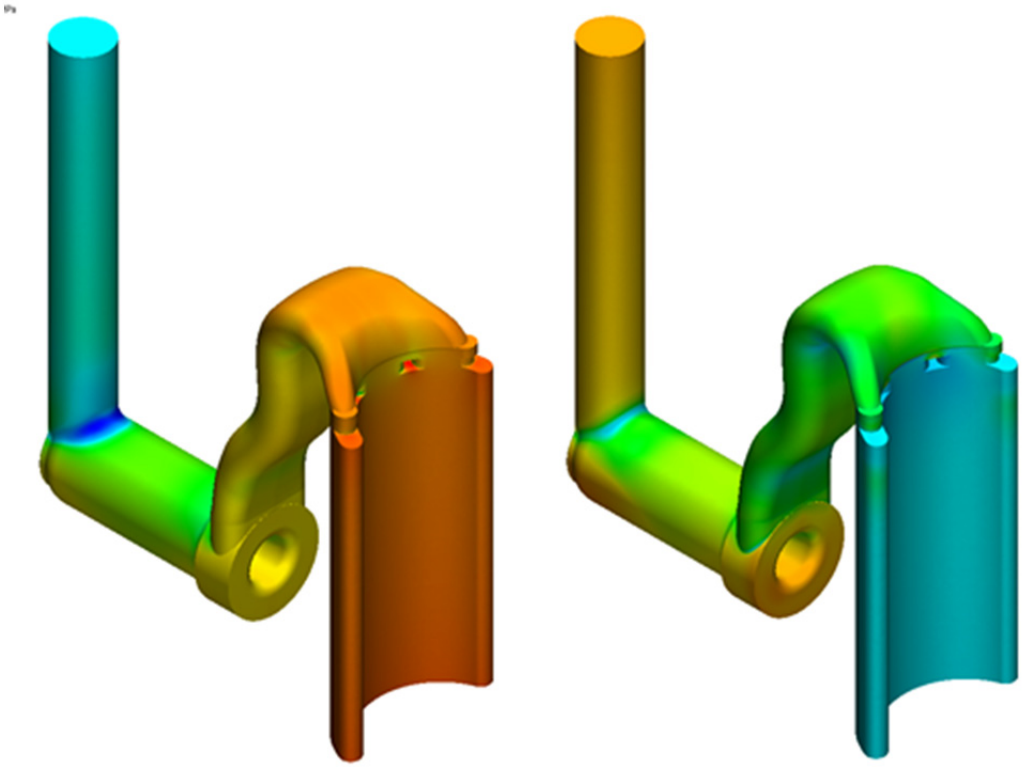


Figure 2: The CFD analysis determined the pressure drop for the piston pump in both pump and motor mode. The pressure drop across bends, expansions, constrictions and other discontinuities is dependent on the direction of flow.

Figure 3: A cut-away of an example piston pump shows the internal pistons and swash plate that transfers the hydraulic energy to mechanical energy and vice versa.

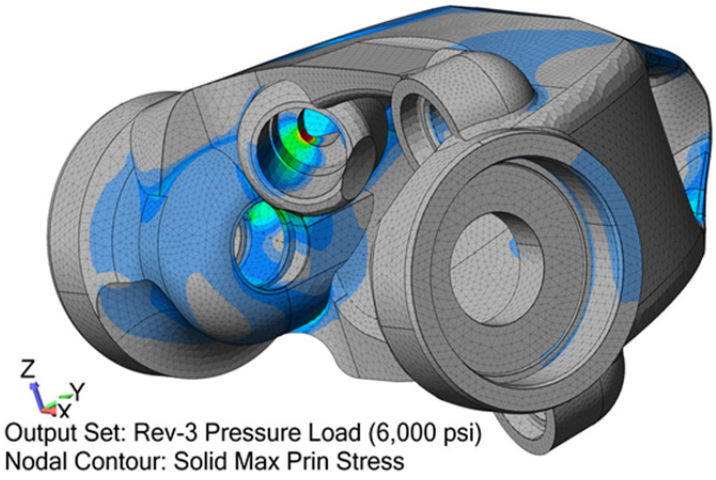


Figure 4: Starting with the same CAD geometry, a finite element analysis model was created to calculate stresses generated by the high-pressure hydraulic fluid. The combination of the CFD and FEA models facilitated a design that reduced pressure drop while keeping stresses below code allowables.

Contact

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