Concrete boom pump trucks are used to transport concrete to construct high-rise buildings and other difficult-to-access sites. Typical truck boom lengths can range from under 20 to over 60 meters (65 to 200 feet). As boom length increases, machine operational challenges also increase. In operation, as the boom is maneuvering and pumping concrete, it tends to oscillate because of the mechanical flexibility of the boom and the compliance of the hydraulic oil in the cylinders. To address the oscillation, additional workers are typically required to hold the boom tip hose and concrete pumping speed is also decreased. This, in turn, reduces machine productivity and increases the potential risk for the operators securing the boom.

The power of CMA
The Eaton CMA advanced mobile valve’s unique features and onboard intelligence enable it to address the concrete boom oscillation issue. The CMA valve’s integrated pressure sensors and precise valve position control feedback enable the valve to provide smooth and accurate flow control above and beyond stock hydraulic valves. Additionally, this onboard sensing coupled with the independent metering capability and Eaton’s proprietary boom stability control algorithm allows the valve to counteract the induced oscillations in the boom. The CMA valve provides the boom stabilizing function without any external sensors, keeping the system simple and easy to integrate.

Manual override control on each valve is also available for customers requiring a redundant means for the safe return of the boom.

Control system integration
Setting up communications between a machine level supervisory controller and electrohydraulic components can often be challenging and time consuming, but Eaton’s Pro-FX Control aims to change that. Pro-FX Control provides a platform to quickly and efficiently generate application logic with Eaton’s supplied control libraries, function blocks and CAN stacks. In the concrete boom application, the operator uses an Eaton OMNEX wireless controller to control the boom position. The OMNEX base unit transmits the operator commands via J1939 CAN bus to the HFX supervisory controller. The HFX controller leverages the integrated OMNEX libraries to quickly process operator commands and translate them into CMA valve commands. The CMA library block packages the valve commands and transmits them to the CMA valve via the same J1939 CAN bus. The boom stability control logic is enabled over CAN and controlled entirely on the CMA valve’s onboard controller. The HFX also enables custom function blocks to be written by the user to accomplish additional functions or control other devices from the HFX. Utilizing the Pro-FX Control function blocks for this machine platform significantly reduced the component integration effort, allowing a quick turnaround for the customer.

Eaton’s full suite of capabilities
In conjunction with the Pro-FX tools, the boom counterbalance valves and manifolds are from Eaton’s leading portfolio of screw-in cartridge valves. These valves and manifolds provide the boom load holding when the machine is static and provide the industry standard safety backup in the event of a failed hose.
Conclusion

The Eaton boom stability control system provides a 90 percent reduction in boom settling time and a 75 percent reduction in tip movement during pumping operation. This allows for the boom to be positioned easier and without significant effort from additional workers. Additionally, reducing the oscillation allows operators to increase machine productivity and expedite building construction.

Eaton’s broad portfolio – CMA valves, HFX/OMNEX controllers, the Pro-FX development platform, and expert application support – provides all the tools necessary for an OEM or distributor to create high-value, differentiated machines at the fast pace the marketplace demands.

Learn more about the Eaton CMA valve at www.eaton.com/CMA
Learn more about Eaton’s Pro-FX portfolio at www.eaton.com/profx

The image above represents a general architecture for the boom stability control (BSC) system on a concrete pump truck. The onboard intelligence and control capabilities available within the CMA valve are the key enabling technologies for BSC to function. The overall components included in the system are flexible and can leverage the existing original equipment sensors, controllers and valves if they meet the necessary requirements.

The test shown above is a simulated pumping case, where a rope is tied to the tip of the boom and used to inject a cyclical disturbance on the boom structure, similar to pumping concrete. At the start of the test, the rope is pulled for 10 seconds and then released to measure settling time. For the baseline case, the pressure ripple, which correlates to boom movement, continues to grow in amplitude until the disturbance is removed. Even without the disturbance, the boom requires an extended period of time before it returns to the stable, starting condition. The boom stability control system, however, maintains a small pressure ripple throughout the disturbance stage, correlating to a significant reduction in boom tip movement. Additionally, any small vibrations present in the boom are quickly dampened once the disturbance is removed from the boom.