• EDITED BY **MIKE SANTORA**

Servo valves key to building better test bench

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Major storms like Winter Storm Blair and Hurricanes Helene and Milton aren't the only threat to the nation's power grid. Earthquakes, too, can knock out high-voltage electrical grid infrastructure. To protect these assets and other civil structures from seismic stress, engineers manufacture damping systems, some of which reduce vibration by up to 80%. One way to design and tune these high-performance solutions prior to installation is with hydraulically actuated seismic test benches.

Test benches enable engineers to use a controller and collect data on specimens situated on either side of a bench, separated by a reaction block. A hydraulic shock dyno oscillates dampers at different speeds (from 200 to 2000 mm/sec) and then measures the force of the shock at various velocities. Heavy-duty hydraulic cylinders on each side hold their respective test specimens in position against the reaction block. Some of these cylinders can apply up to 800,000 newtons.

Recently, engineers at a facility that manufactures damping systems faced some challenges with their test bench. The engineers wrestled with controlling pressure, collecting data, maintaining up-time, and swapping test specimens in and out. To tackle these challenges, they called Wayland, MI-based Servo Innovations, which specializes in calibrating test systems for the aerospace, automotive, construction, and medical industries.

"The bench wasn't designed as a closed loop for the PLC, and it had the potential for much more flow control, plus it couldn't run tests simultaneously on both sides and periodically leaked hydraulic fluid," said Troy Diller, CEO of Servo Innovations. " The engineers also worked harder than necessary to extract all the data for design decisions, and the bench's safety controls were manual."

Diller noted several issues. First, test data collected by microphones and cameras was running through Dewesoft Acquisition Software, which required continual calibration. Next, an array of switches was needed to change a test specimen. If there was a problem running a test on one half of the bench, the other side typically shut down. Third, the bench relied on specialized software, and when the test bench manager ran a ramp, the system couldn't make that happen via both load control and displacement; it was one or the other.

Building a better bench

To precisely control the position of and pressure to the bench's cylinders, Diller and his team first replaced the existing valves with three Moog Direct Drive Valves and a Moog 3-Stage Flow Control Servo Valve. Diller changed the setup for the bench's servo valves while incorporating Temposonics' linear position sensors. He then plugged the bench's cameras and microphone monitoring systems into analog inputs, so the engineers no longer had to pull data off a box to determine displacements.

"Our approach was to precisely set the flow to the cylinders versus trying to slow down the pressure," added Diller.

Diller's team replaced the bench controller with a Moog Controller and Moog Control Software. The bench

typically runs bigger seismic tests on one side and shorter ones on the other. Servo Innovations solved the problem of periodic stoppages by running each half with one controller.

"The Moog Control Software also lets the engineers run a test using the Moog components, extract data immediately, and then quickly run a different test," Diller said.

According to Diller, there is now better throughput and data consistency.

"The controller they had in place was ripe for an upgrade, especially when you add multiple valves in parallel or series as we were doing," said Diller. "You'll have one or two valves fighting to be the master. So, when you set up something like this, you have offset issues; one valve will feel the other and shift slightly."

To get the maximum amount of flow, Diller had to strike a balance between a group of valves. The Moog system, says Diller, can shift offsets slightly, and the valves work to balance themselves out. With the previous controller, the test engineers were trying to do this with a series of movements, but each step fell behind the next operation because the system is not fast enough when running at, for example, 10 kHz resolution.

"With the valve configuration we put in place, the operation is a lot faster; they don't have to worry about the timing problem," said Diller. "When the controller tells a drive to move, it's outputted to that valve. One output affects the three valves enabled with a digital I/O, and it's instant instead of stepped."

"Load control is very important to a test bench," Diller noted. "Engineers want to preload the shock and shock configuration to a specific point and zero it out. Then they want to do a rebound for which they can calculate reaction time on a football plot."

The new servo valves, Moog Controller, Moog Control Software, and integration with the sensors and PLC have streamlined the process and made it repeatable for accurate control every time. DW

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