

Machine building

Customer case study



SAM: Another brick in the wall with automation

Summary

- While traditional masonry techniques have stood the test of time, they are time- and labor-intensive.
- Construction Robotics' Semi-Automated Mason (SAM) system helps masons do more with less by automating this process.
- Since SAM works on-site, the components need to withstand a variety of environments: wind, dust, rain, and other harsh conditions.
- Phoenix Contact wireless modules, sensor actuator cables, and other components met these tough requirements.

“Precision and quality are important aspects of what we’ve chosen. We looked for products that were robust and at a good cost, as we were trying to develop, test, re-engineer, test again, etc.”

Zachary Podkaminer, Strategy and Business Development, Construction Robotics

Customer profile: Construction Robotics

Mortar, bricks, trowel, chisel, string line: these are the same basic tools that masons have used for hundreds of years. While there have been improvements in scaffolding systems and mixers, if you watch a masonry video from the 1940s, you will see very few differences in technique compared with today’s construction sites. These traditional methods have stood the test of time, but they are also time- and labor-intensive.

Construction Robotics, a start-up company from Victor, N.Y., was founded in 2007 with the goal of bringing automation technology to on-site construction. The company’s flagship product is the Semi-Automated Mason (SAM), a robotic bricklaying system. SAM100 is designed for the construction site and helps masons improve efficiency.

Challenge: Fewer masons to perform labor-intensive work

Masons traditionally have relied on string line to measure bricks. They calculate the size of the wall based on the size of the bricks, and determine the size of the head joints between them. The mason applies the mortar to the wall and places the brick on top.

While the method is tried and true, it is labor-intensive and can lead to imperfections between head-joints. Zachary Podkaminer, Strategy and Business Development, explained, “Go from one end of a brick wall to the other, and you will often notice some imperfections between head joints. You might see a bigger or smaller joint near the end, to make the brick fit.”



Construction Robotics' flagship product is the Semi-Automated Mason (SAM), a robotic bricklaying system. This automated machine helps masons improve efficiency.

SAM, on the other hand, relies on sophisticated lasers to precisely measure the dimension of the bricks. Each brick is individually measured, and the lasers can detect even small variances between the bricks. The measurement is very precise, and makes it possible for SAM to calculate the exact size of each mortar joint, so they are all identical.

According to Podkaminer, the original prototype developed in 2012 was not very practical. “Our first prototype was to prove a robot could install bricks on a construction site. It was a massive 5,000 pounds, and couldn’t be easily moved. But we learned to make it smaller and lighter. This improved the speed and accuracy. The quality improved, and the ability to put in a wall is a lot better. The whole process is simplified.”



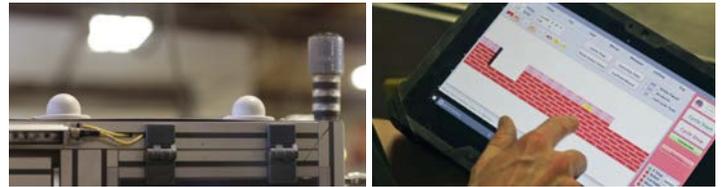
SAM's laser system measures each brick individually and can detect even small variances between the bricks.

Solution: Precision control with wireless Ethernet

To help improve the machine design and efficiency of SAM, Construction Robotics turned to local automation distributor Kaman ACE (Automation, Control and Energy). The new generation of SAM relied on many Phoenix Contact components, which helped streamline the size of the cabinet and ensure quick and easy installation.

SAM uses Phoenix Contact industrial wireless Ethernet products to provide secure, reliable communications. The FL WLAN 5101 is the access point located in the main control cabinet. It provides wireless links to a remote laser system and SAM's HMI. The remote laser system (Smartline) is used as the string line that positions where SAM lays its next row of bricks. The HMI (a rugged tablet computer) provides the operator information on SAM's performance.

SAM has a number of different sensors and actuators and lighting components. All of those are fed through Phoenix Contact's Ethernet-based Axioline I/O, which communicates back to the



Phoenix Contact's FL WLAN 5101 wireless module, located in the main cabinet, provides wireless links to a remote laser system and an HMI on a handheld device.

SCADA system that controls the machine. The control panel also includes Push-in Technology (PT) terminal blocks. The quick connection technology on these components reduced installation time. In the event of a main power loss, the compact, dual-output QUINT UPS (12/24 V DC) provides reliable battery backup to two critical control circuits.

Since SAM works on-site, the components need to withstand a variety of environments: wind, dust, rain, and other harsh conditions. Phoenix Contact's products are designed for reliable operation at these demanding locations.

“Precision and quality are important aspects of what we've chosen,” Podkaminer said. “We looked for products that were robust and at a good cost, as we were trying to develop, test, re-engineer, test again, etc. We needed to move at a fast pace, so one of the deciding factors was availability and turnaround time. If something was going to be delivered in eight to twelve weeks, we needed to know the exact times.”

Results: SAM100 in action

Once SAM has completed the laser measurements for the wall, it can run continuously in a given setup for hours on end. A mason sets up the wall and follows along, tooling joints and ensuring wall quality, while a tender keeps the system fed. Depending on the variables – such as the size of the bricks and the mason's experience – a mason can typically lay between 400 and 600 bricks per day. SAM can currently lay between 350 and 400 bricks per hour. Not only can SAM eliminate the need for overtime, but it doesn't get tired.

However, Construction Robotics does not see SAM as a replacement for masons, but instead as a solution that makes it easier for a mason to perform a quality job. SAM reduces the physical strain on the mason and crew, allowing the mason to focus on tooling joints and wall quality. This can improve the health and safety of the workforce, ensuring a consistent production rate and performance. This is especially valuable in markets where labor is in short supply.

SAM on the job

Currently, Construction Robotics has built eight SAMs, of which they have sold four, while the other units are part the company's rental fleet and are deployed across the country. The company is building four more, with help from Kaman and Progressive Machine & Design.

Conclusion: Advanced technology

For contractors used to paying for ongoing labor costs rather than an up front investment in a machine, SAM requires a different mindset. With SAM's help, masons will have a safer work environment and have the opportunity to focus on the quality of the job. Builders can improve efficiency and consistency in a cost-efficient way.

A few Construction Robotics customers shared how they think SAM is changing the industry:

"The masonry industry is aging, and the new tradespeople coming into it are few and far between. This is a really wild, innovative new invention that would allow us to supplement our existing forces, not replace them. It's something Brawdy Construction is really excited about."

– Ryan Glenn, Brawdy Construction



Construction Robotics uses over a dozen sensor actuator cables on SAM, linking them in with the I/O, the lighting, and communication products from Phoenix Contact.

"Not only was SAM able to integrate seamlessly into our masonry crews, but on shorter walls, we were able to transition SAM from finished wall to start of a new wall in less than 15 minutes, minimizing costly downtime."

– Justin Mitten, J.H. FINDORFF & SON INC.

"Bringing SAM100 onto our team allows us the closest technology equivalent to having an additional mason onsite. The robot doesn't eliminate our masons at all. It simply helps them do more with less crew, while minimizing the physical stress of repetitive brick-lifting motions."

– Andy Sneed, CEO, WASCO Masonry