

CONSTRUCTION ROBOTS TAKE ON DULL AND DANGEROUS TASKS

BY MARY LOU JAY

You won't find the newest worker on Turner Construction Co.'s New York City job sites wearing a hard hat and wielding a hammer. But that's okay with the company. SPOT, a four-legged, bright yellow robot from Boston Dynamics, is focusing on a different task: navigating and scanning the job site to record progress of construction projects.

"We're very interested in robotics and trying to figure out what unique value they can provide to the job site. There's no intent or desire to replace humans. We want to know what they can do that a human can't do very well," said James Barrett, vice president and chief innovation officer at Turner Construction Co.

Working with Boston Dynamics, Turner has been testing SPOT since last August. The robot has been using its payload of 360-degree-view cameras, laser and Light Detection and Radar (LIDAR) scanners to document work that has been done. That is a job Turner staff members usually take on. "Documentation is one of those tasks that isn't difficult; it is just rather laborious, consistently walking through a space. It takes a fair amount of time, and there are other activities that our staff could be doing that are a higher value-add," said Jennifer Downey, the company's director of innovation.

Staff members also get interrupted when people stop them to ask questions. While other workers may stop work to watch SPOT, at least until the novelty wears off, that scrutiny won't stop the robot from continuing on its path.

Downey operates SPOT using an Android-based tablet. A joystick enables her to steer the robot, or she can click on the tablet screen at a certain map location and have SPOT navigate to that point. There's also an autonomous mode. Downey can walk the robot along a certain route, placing markers (fiducials) that help the robot get its bearings. After the programming walk, the robot can repeat the path on its own, using the fiducials to find its way and the cameras to "see" any obstacles.

DOWNEY PROGRAMS SPOT FOR A DAY ON THE JOB IN NEW YORK CITY.

Photo Credit: Turner Construction Co.



BOSTON DYNAMICS' SPOT UTILIZES 360-DEGREE-VIEW CAMERAS, LASER AND LIDAR SCANNERS TO DOCUMENT WORK.

Photo Credit: Turner Construction Co.

SPOT's ability to navigate obstacles is one thing that Turner is testing. "How many things can change along that walk before SPOT gets deadlocked and doesn't know where it is? A construction site is so dynamic that you have to work on the assumption that things are not going to be in the same place the next day," said Downey.

SPOT does some things very well, like walking across a metal deck with rebar on it. That's difficult for humans. But other things, like a puddle of water, might bring it to a halt. Boston Dynamics said that large, deep pools of still water with reflections — and mirrors in general — are a known perception challenge for SPOT. Adjusting the friction settings for the increased drag of the water and decreased speed does help.

As Boston Dynamics gets feedback from Turner and a few other construction company partners, it's been upgrading the software to make the robot easier to operate.

ADDING VALUE

While SPOT itself is attracting most of the attention on the job sites, it's the data being collected that's most valuable to construction projects, said Barrett.

"Our thinking is that the progress monitoring is probably one of the strongest use cases, because that's something we do in a very manual process right now," he said. Since laser scanners don't need light, a robot might eventually walk the job site at night on its own, capturing the current state of the project every day. Those scans could be loaded into BIM models and other software programs to check what's actually happened on site. At present, it's too expensive and labor intensive to have people perform daily or weekly scans; a robot might make that more economically feasible.

"We're also talking to a company that sells asset tagging and tracking technologies. If you tag things on the floor and put an RFID reader on SPOT's back, it could walk around the site and be constantly pinging those RFID tags. You would have a real-time update of where assets are on the floor," said Barrett.

Both Barrett and Downey expect there will be more robots on job sites as time goes on.

“I really do think that robots will be part of the job site future as we get a better understanding of the tasks on which they can assist and augment our job site staff,” Downey said.

REDUCING INJURIES, INCREASING PRODUCTIVITY

Construction Robotics has developed two robots: SAM (semi-automated mason) and the MULE (material unit lift enhancer) for use in the masonry trade.

Scott Peters, the company’s president and co-founder, said robots can help solve some chronic industry challenges like labor shortages, labor costs and lack of production predictability. They could also relieve workers of some of the dangerous and difficult lifting tasks that can result in back and shoulder injuries.

The SAM robot functions as a partner to the mason, who measures and lays out the wall, programs the machine and then feeds it brick and mortar. The robot lifts each brick, adds mortar and then places it into position. The mason still performs tasks like striking the joints and installing wall ties and flashing.

The robot can’t lay bricks faster than experienced masons, but it does offer repeatability, consistency and quality, Peters said. Unlike a mason, it doesn’t get fatigued or hurt, so it can perform the task over and over again. On one project, a SAM worked around the clock to get a job completed more quickly.

The company first demonstrated its SAM robot in 2015. SAM models have worked on several projects throughout country since that time, including a few in the greater Washington, DC area.

Construction Robotics’ MULE is less sophisticated but has gained wider adoption than SAM. It is a basic robot that reduces the stress of lifting for masonry workers. Its function is to pick up a block and weigh it, then hold it for the mason who moves it into position. “Users interact with it very naturally; they can push on the block, up, down and sideways, and it feels weightless to them,” said Peters. The “smart” part of this robot is how it weighs each block and adjusts its movements for that weight.

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CONSTRUCTION ROBOTICS’ MULE HELPS A MASONRY WORKER TO PICK UP BLOCKS AND HOLD IT FOR THE MASON WHO PUTS IT INTO PLACE.

Photo Credit: Construction Robotics



**“ONCE ROBOTS ARE MORE COMMON ACROSS THE INDUSTRY, THEIR CONTRIBUTIONS WILL LIKELY BE SIGNIFICANT AND WILL AUGMENT THE WORKFORCE WITH REDUCED RISK AND INCREASED REWARDS.”
— JOSH CHENEY**

As the use of the MULE grows, Peters said some block manufacturers have begun producing bigger blocks — 32-inches long instead of the typical 16 inches — because the masons can now handle them safely. That has the potential to double job-site productivity.

“Mason contractors who want to push the envelope may change the logistics on job sites to take advantage of the productivity gains they can get with a MULE. They don't need to worry about injuring their men, or limiting their productivity because of fatigue,” said Peters.

THE ROBOT POTENTIAL

As the cost of robots falls and their capabilities increase, robots will become a more common construction tool.

“The initial investment is expensive, and the use cases are still being developed, but robots have already begun impacting the way construction projects are designed, planned, executed, commissioned and operated,” said Josh Cheney, senior manager of strategic alliances, Autodesk Construction Solutions. “We have seen a rise in data gathering, completing repetitive and/or dangerous tasks and working alongside humans.”

Contractors and workers continue to have concerns about robots taking over jobs, about the quality of their work and about how far they can trust robots as they become more intelligent. But robots offer advantages that may be hard to pass up. When used for job site inspections and progress tracking, for example, they can not only take over tedious tasks — freeing humans up for critical thinking tasks — but also speed up data processing by seamlessly integrating with other programs. A SPOT robot equipped with Autodesk's HoloBuilder's 360-degree photo capture can push imagery into the Autodesk Construction Cloud with next to no human intervention.

“In the age of COVID-19, it's also helpful to have these robotics applications in place so we can minimize potential exposure,” said Cheney.



“Robotics have come a long way in a short period of time, and the demand for construction paired with the industry's workforce shortage, digitization and need to keep workers safe can certainly encourage the adoption of robots,” he added. “Once robots are more common across the industry, their contributions will likely be significant and will augment the workforce with reduced risk and increased rewards.” ■

THE SAM ROBOT PARTNERS WITH A MASON TO LIFT EACH BRICK, ADD MORTAR AND LAY BRICKS INTO POSITION.

Photo Credit: Construction Robotics