

# Automated Assembly

Simon Davies

How will the future be constructed?

**The use of automation in construction has created new possibilities once thought impossible.**

In recent years, there has been a huge growth in the development and use of automated technologies within the field of construction. Such technologies are growing ever more complex and diverse, creating new avenues of exploration. There are a few well known automated construction types such as brick laying robots and 3D printed concrete, however there are other growing forms of automated construction that are just recently grabbing attention.

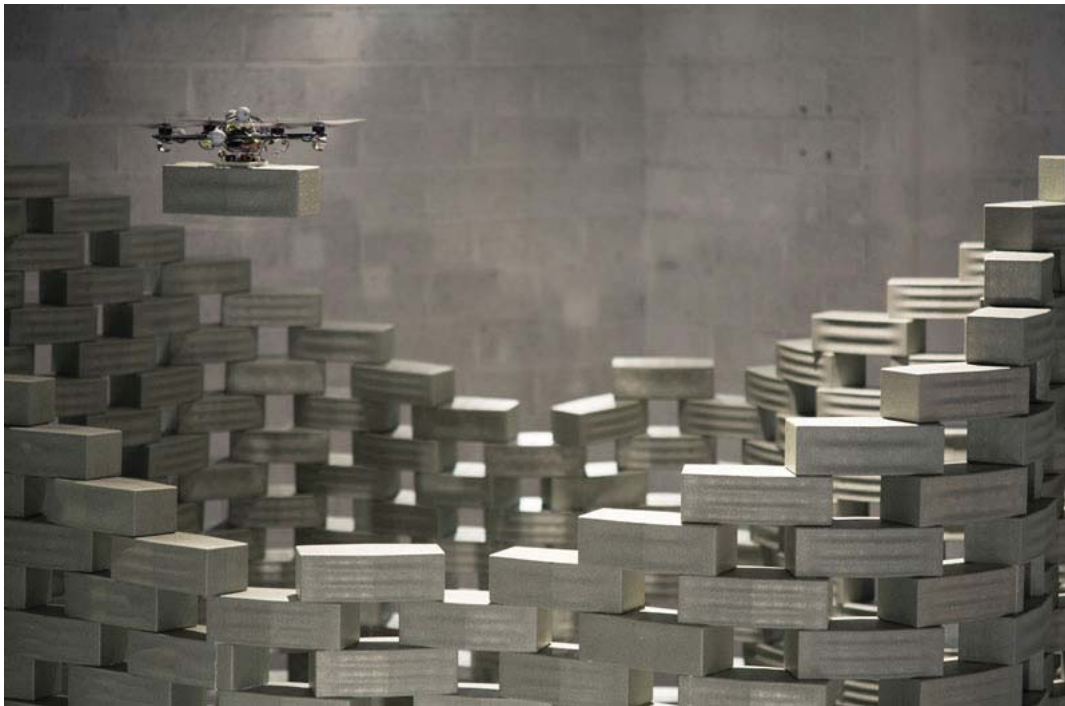
This growing diversity in construction solutions allow us to explore different approaches to building construction and creates new opportunities in education and analysis of the built environment. It is important to think about not just the robots themselves and the work they do, but how they are programmed and how a specific task requires a great understanding of that task and how to complete it. This study investigates different methods of construction and their possible future applications.



# Current Solutions

## Building With Drones

The use of drones in the constructed industry has exploded as they allow us to carry out inspections of an in-progress building. With built in cameras and specialized sensors can collect large amounts of data easily saving the cost and risk associated with a human inspection of hard-to-reach areas. However, it wasn't until recent years that drones were really put to work.



Architecture firm Gramazio Kohler has developed a way to program drones to carry out the brick assembly of a tower design they developed. With the combined use of technology within the drones such as high resolution cameras, laser scanning rigs, and gyroscopic stabilization, they are able to return highly precise and accurate data. While their ability to stack bricks is impressive, the programming that goes into the drones is even more impressive. Multiple motion capture sensors detect the drones feeding the information to a fleet management program, the algorithms created determine how the drones move efficiently, avoiding collisions, and creating the most efficient flight paths for the many drones used. Could these drones be used at a much larger scale? Could they lay brick and mortar? Gramazio Kohler is well versed with robotic construction and they also helped create R-O-B Technologies, which has developed a mobile fabrication unit that has been able to perform many tasks so the future looks bright for these flying masons.

## Self Assembling Robots

The idea that buildings could build themselves has always been a peculiar topic once thought impossible. It wasn't until 2011 when a student at MIT, John Romanishin, proposed a design for modular robot cubes that could stack themselves. Known as M Blocks these cubes contain an internal flywheel that, when braked, transfers its rotational momentum to the cube. Each edge, corner and face of the cube contains magnets allowing the cubes to snap together.

This design was based of the sliding cube model, an abstraction used by researchers studying reconfigurable robots. In this model, if two cubes are face to face, one of them can slide up the side of the other and, without changing orientation, slide across its top. This model simplifies the development of self-assembly algorithms although the robots are usually much more complex.

"There's a point in time when the cube is essentially flying through the air," Gilpin says. "And you are depending on the magnets to bring it into alignment when it lands. That's something that's totally unique to this system."

Although currently this technology has no applicable use, researchers hope to miniaturize these modules creating a swarm of molecules that self-assemble into any form. This could be useful in not only the building itself but also in aiding the processes of construction such as material transportation and creating temporary structures or jigs that help builders build. The modular cube group could also contain specialized cubes containing cameras, lights, batteries, or other equipment.

"We want hundreds of cubes, scattered randomly across the floor, to be able to identify each other, coalesce, and autonomously transform into a chair, or a ladder, or a desk, on demand," Romanishin says.





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