*NATURE* | NEWS

# Ant colonies flow like fluid to build tall towers

**Insects' structural secrets offer model for designing swarm robots.**

**Laura Castells**

12 July 2017

To cross streams or secure themselves against water currents, fire ants join forces to form rafts or build towers. Researchers have now worked out how the ants sustain tall structures without crushing their friends: they constantly circulate around the tower, behaving like a fluid.

Fire ants (*Solenopsis invicta*) have sticky pads on their feet that help them to assemble collectively into shapes.

Researchers had already worked out the secrets of fire ants' raft-building techniques: the ants adhere to each other with their feet and orient themselves to create pockets of air, distributing their weight to form a buoyant structure. So a team co-led by Craig Tovey, a modelling mathematician at the Georgia Institute of Technology in Atlanta, sought to find out how the insects sculpt themselves into towers.

In a laboratory, the team used high-speed cameras to record how the insects assemble around a slippery Teflon rod, and tagged half the colony with a radioactive tracer to see how the insects moved inside the tower structure.

Secrets of ant rafts revealed

The ants use trial and error to form a tower, continuously rebuilding weaker parts that collapse until the structure is sound. Each individual insect can support up to three other ants, the researchers found. And when an ant is overloaded, it lets go of its neighbours and sinks down the column until it emerges outside the base of the tower.

The result is a dynamic, bell-shaped structure that moves similarly to a fluid, and in which each ant carries an equal load. "The ants are circulating like a water fountain, in reverse," says Tovey. The work is published in *Royal Society Open Science*[1].

**Dynamic structure**

Scientists knew that the tower structures were dynamic, but the videos mark the first recording of the phenomenon, says Guy Theraulaz, an animal-behaviour researcher at the Research Centre on Animal Cognition in Toulouse, France.

The team was also able to predict the shape and growth rate of the towers using mathematical models. They already knew that when fire ants form rafts, the feat depends on the behaviour of individual ants rather than on colony members following a central command. This individual behaviour can be described by three basic rules that can be fed into an mathematical model of the structure.


**Related stories**

- Researchers create 1,000-robot swarm
- Termite-inspired robots build castles
- Ants team up to stay dry

**More related stories**



**Related stories**

- Researchers create 1,000-robot swarm
- Termite-inspired robots build castles
- Ants team up to stay dry

**More related stories**


The researchers were surprised to find out that when the ants build towers, they obey the same rules. The two shapes are different: the raft is static and tower dynamic, says Tovey. “Yet both structures follow the same decentralized rules.”

The findings could help robotics researchers who are trying to work out how to program swarms of minuscule robots to achieve a greater goal. “Understanding how ants can build this variety of sound 3D structures following a very set of simple rules can help to figure out how program tiny multipurpose robots,” says Tovey. “The next step is to figure out how they build bridges.”


*Nature* doi:10.1038/nature.2017.22290


## References


1. Phonekeo, S., Mlot, N. J., Monaenkova, D., Hu, D. & Tovey, C. *R. Soc. Open Sci.* **4**, 170475 (2017).