

It could be the house that Mac built, put together in 24 hours, writes Margaret Wertheim.

On my computer screen a house is going up. Before my eyes the building materialises rapidly as layer upon layer of concrete is laid down, each strata squeezed out of a huge nozzle as if from a gigantic toothpaste tube.

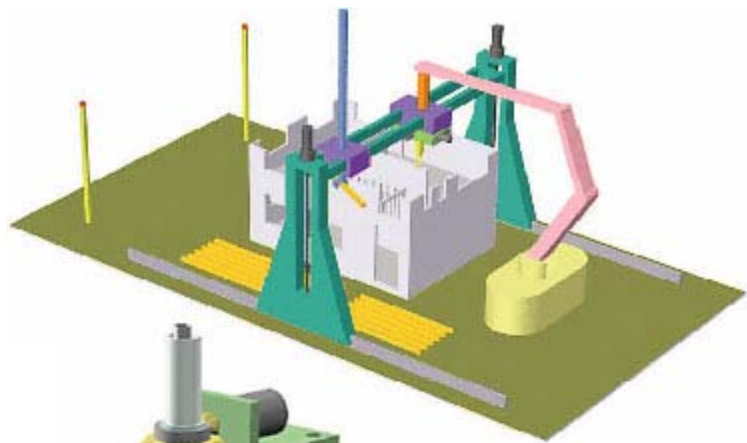
This is not the construction of an actual house - not yet, anyway. What I am watching is an animation of the way in which houses of the future may be built.

Known as Contour Crafting, the process is the brainchild of an engineering professor, Behrokh Khoshnevis, of the University of Southern California.

Professor Khoshnevis believes that his technology will make it possible to build a house from foundation to roof in less than 24 hours: "Our goal," he says, "is to be able to completely construct a one-storey 185-square-metre home on site in one day, without using human hands."

With Professor Khoshnevis' system the entire building process would be automated using robotic equipment brought in.

Whole enclaves could be built in weeks - just add cement and press the start key. But while the process itself is robotic, Professor Khoshnevis says each house could be a unique design. Indeed, he sees his technology as a way to make



A Khoshnevis house under construction, and the huge nozzle mechanism, left.



individually tailored houses practical and affordable on a wide scale.

The machines the professor has designed can create any kind of three-dimensional structures, from simple cubes and boxes to domes, cylinders and cones, and even irregular curves.

"Architects love this technology," he tells me. Structures that have never before been possible suddenly become as easy as rectilinear slabs.

The idea for his system came to Professor Khoshnevis one day while he was patching up some plaster in his living room.

"It occurred to me," he says, "that in car manufacturing we build much more complicated structures all the time." So why not apply the idea to houses?

His system is based on a technology known as rapid prototyping that is used to fabricate industrial models and prototypes, particularly in the car and aerospace industries.

First a digital model of the object is created with software, then under computer control a physical version is built up layer by layer.

The crucial issue here is scale. Car parts might be complex forms but by and large they can be measured in centimetres.

Houses, by contrast, are enormous. Professor Khoshnevis' main challenge so far has been working out ways to implement a large-scale rapid prototyping system. Next month he will test out his first house-size version using grant money provided by the US National Science Foundation. That test system will build only a simple straight wall, but Professor Khoshnevis is talking to the foundation about a multimillion-dollar grant to put together a full production version.

In his workshop, Professor Khoshnevis has already built a small test system that can turn out objects from a just few centimetres in diameter to about 30 centimetres across.

When I visited him a dozen of these enigmatic forms were arrayed on a shelf. Made out of white clay, their rounded shapes call to mind the traditional adobe structures of the American south-west. One can easily imagine them scaled up to building size.

Fluid and elegant, they would be equally suited to a desert landscape or a futuristic city. I've always longed to live amid curves, and I ask Professor Khoshnevis if it is really conceivable that we could build such structures on a suburban plot. He assures me that in principle this is child's play.

"For decades we've been doing much more complex things with robotics," he says. "This is all very simple assembly."

In vehicle factories the robots are fixed in place. To build houses, Professor Khoshnevis' equipment would have to be taken to the site. His animation shows what such a set-up might look like. Along the sides of the virtual plot two large rails are installed - think of oversized railway tracks. Perched on the rails is a moveable gantry, and attached to that is the nozzle machinery. Beside the rails stands a tank to hold the building material, usually concrete, or some kind of composite.

Professor Khoshnevis punches the start key and the animated gantry begins to slide up and down the rails while the nozzle emits a steady stream of material in a precise pattern predetermined by the architect's design.

In a typical rapid prototyping system, each layer is just a fraction of a millimetre thick. Professor Khoshnevis' layers would be around six or seven centimetres deep. The main factor determining how long it would take to build a house is the drying time of the concrete - each new layer can be laid down only once the previous layer has dried. Professor Khoshnevis' team includes a concrete expert who has been testing different formulations, but he notes that adobe is also a natural material for this type of construction.

Another name for rapid prototyping is "object printing" - in effect printing a house. The gantry system with its concrete-spouting nozzle is essentially just a heavy-duty version of an ink jet printer. The team has also worked out a fully automated system for putting in the pipes and electrical conduits. They could even automate the painting, literally printing colours and patterns directly on to the walls.

But is home building something we should be trying to automate?

Professor Khoshnevis believes the answer is yes. Skilled construction workers are increasingly scarce, he notes, and each year in the US more than half a million people are injured on construction sites.

Moreover, with traditional building methods, material wastage is enormous - three to seven tonnes is typical for a suburban house. Professor Khoshnevis claims his technology would cut waste, reduce accidents and save money. He estimates a cost saving of at least 50 per cent on a typical suburban house.

It's hard to imagine construction unions taking this lying down, and union opposition is expected. But the professor points out that we are moving towards a society in which just about everything else is fabricated by machines. Why should houses be different, he asks?

<http://www.theage.com.au/articles/2003/10/04/1064988452900.html?from=storyrhs>