

Moritz Mungenast in the Frankfurter Allgemeine

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The long road to a printed home.

From Felicitas Witte, Frankfurt

During the Corona crisis, it was once again apparent how valuable it is to have your own home with plenty of space. Now some may have considered the plan to finally build their own home. If you believe media reports, houses made with the 3D printer (3D stands for three-dimensional) are supposed to be the "next revolution in house building". There is enormous potential in 3D house construction, says Moritz Mungenast, architect and researcher for design and building envelopes at the Technical University (TU) Munich. "But Germany is lagging far behind. Unfortunately, good ideas hardly ever end up on the building site".

3D printing would be extremely attractive for the construction industry, says Klaudius Henke, architect at the Chair for Timber Construction and Building Construction at the TU Munich. "You save on material, which costs less and protects the environment. In addition, we can integrate insulating material or shafts for pipes and cables during printing". Dozens of research teams around the world are competing to determine which is the best 3D technology. Extrusion was often used in previous 3D houses. A robot arm sprays printer ink - for example concrete - layer by layer on top of each other in the form of sausages, like cream from a piping bag. Henke and his team are researching the optimal composition of the concrete ink. One contains wood in addition to cement and water. They are printing wall elements that are later assembled like a Playmobil house. The wood shavings make the wall lighter and also have an insulating effect.

In another project, Henke's team is testing another printing process, selective binding. Put simply, thin layers of sand are first printed, and where the solid concrete structure is to be created - for example, a lintel - the sand is "glued together" with cement and water. The excess sand is removed, leaving behind the lintel. He can imagine, says Henke, that in the future conventional techniques will be combined with 3D printing. For example, exterior walls made of concrete using the sausage method, stairs by selective binding, and ceilings made of reinforced concrete or wood as before.

Building technology hits the roof.

Benjamin Dillenburger from the Swiss Federal Institute of Technology (ETH) in Zurich also wants to revolutionize ceilings. He is printing the moulds into which concrete is normally poured, the so-called form-work. Making this "cake mould" is the most labour-intensive step in concrete construction. Since concrete is cheap and there is plenty of it, the temptation is great to always produce the same solid ceilings - that consumes a lot of

material. Dillenburger's team prints form-work from sandstone. He used it to produce an 80-square-metre, 15-tonne concrete ceiling for the DFAB House (DFAB stands for Digital Fabrication) in Dübendorf, Switzerland, a three-storey research building on new construction techniques. Dillenburger used the computer to adjust the geometry of the ceiling so that only as much concrete as is necessary to withstand the forces at each point was used. Lamps and sprinklers are integrated into the ceiling, and the holes for them in the wall were cut out during printing. "In this way, the building technology disappears elegantly and 'space-savily' into the ceiling," says Dillenburger.

His colleague Moritz Mungenast from the Technical University of Munich prefers to concentrate on 3D facades, using transparent plastic granulate as printer ink. He and his team print corrugated, milky looking walls that let light in, but through which you can't see inside from outside. The waves can be printed so that they let the sun inside in winter but only indirectly in summer so that it doesn't get so hot inside the house. The wave shape can be designed individually. "Some may want the sun out from May, others from June."

Cavities inside the wall provide stability and insulate against heat and cold, and thin ventilation ducts can also be imprinted. The walls made of plastic could be shredded if you want to move, and new walls could be printed from the shredded granulate. Mungenast dreams of sustainable facades: Instead of oil-based plastic, he wants to use biological residues, for example from lignin, a waste product of paper manufacture, or chitin from the shell of seafood. "The manufacturers of frozen shrimps do not know where to put the waste," he says. "We could make good use of the shells." But it will certainly be a few years before the printed version of the home - even if only partially - is available. "As innovative as 3D printing is - you can't ignore safety," says Dillenburger. "Nobody would be satisfied if the house suffered damage or even collapsed after a few years." According to the model building code, you can also build with new types of construction products, as long as you have a license. This can be obtained from the German Institute for Building Technology (DIBt). Here you have to show which properties the building material has - for example how stable the concrete sausage is - and according to which quality criteria it is produced.

On the other hand, you have to explain what you have to consider when building with the concrete sausage, for example how high you can make the wall. Andreas Kummerow, a civil engineer at DIBt, says that you can't get away with less than 20,000 euros for a product test at a test centre. In addition, 5000 to 20,000 euros would have to be added for the DIBt decision. It can take a year from application to approval, sometimes even longer. "We are sometimes accused that the approval process takes far too long", says Kummerow. "But safety first."

Will 3D printing one day be able to save a lot of money in house building? At the current stage of research, there can be no talk of savings: a printed façade, for example, still costs many times more than a simple standard façade. 3D is still a dream of the future, but it sounds promising.