

# TREND: ADDITIVE MANUFACTURING



## ARCHITECTURE AND CONSTRUCTION WITH 3D PRINTERS

by CREATIVE REGION Linz & Upper Austria  
and Business Upper Austria



**#COCO4CCI**

3D printing has already made a name for itself internationally in the field of architecture and construction, particularly in urban planning. In this article, three experts from Austria are discussing and answering the following questions:

- What changes will 3D printing bring to the construction industry and architecture?
- What is possible with 3D printing in architecture so far?
- And what challenges is the industry facing?



## Sustainable construction with 3D printing

On an international scale, 3D printing has already made a name for itself in architecture and in the construction industry. Architect **Arthur Mamou-Mani**, for example, knows how to skilfully exploit the benefits of 3D printing to create stunning works. Together with Salzburg-based **Studio Precht**, he created the sand-printed urban ensemble **Sandwaves** in Diryah, Saudi Arabia.

**The Sandwaves** is composed of 58 modules that include seating and planters while also serving as brise soleils. The elements blend into the desert and resemble traditional building styles of the region. Since the sculptures were printed from sand, the desert is reflected in the design as well. Additionally, they appear very delicate, which is partly due to 3D printing.



THE SANDWAVES by Arthur Mamou-Mani and Studio Precht; Credits: Arthur Mamou-Mani

But 3D printing doesn't just bring new liberties to designs; the subject of sustainability is also a crucial parameter.

*„In architecture, methods are being sought to conserve resources. With 3D printing technology, it is possible to reduce the mass or weight of a component by increasing the complexity of the manufacturing part,“*

explains Christine Bärnthaler. She is founder and innovation agent at **ofroom**, and is one of the leading trend scouts when it comes to technology innovations in architecture.

Without reinforcements and by saving material, architecture comes closer to a conscious interaction with nature. This involves rethinking not merely the product, but also the production process in order to meet the highest standards of sustainability.

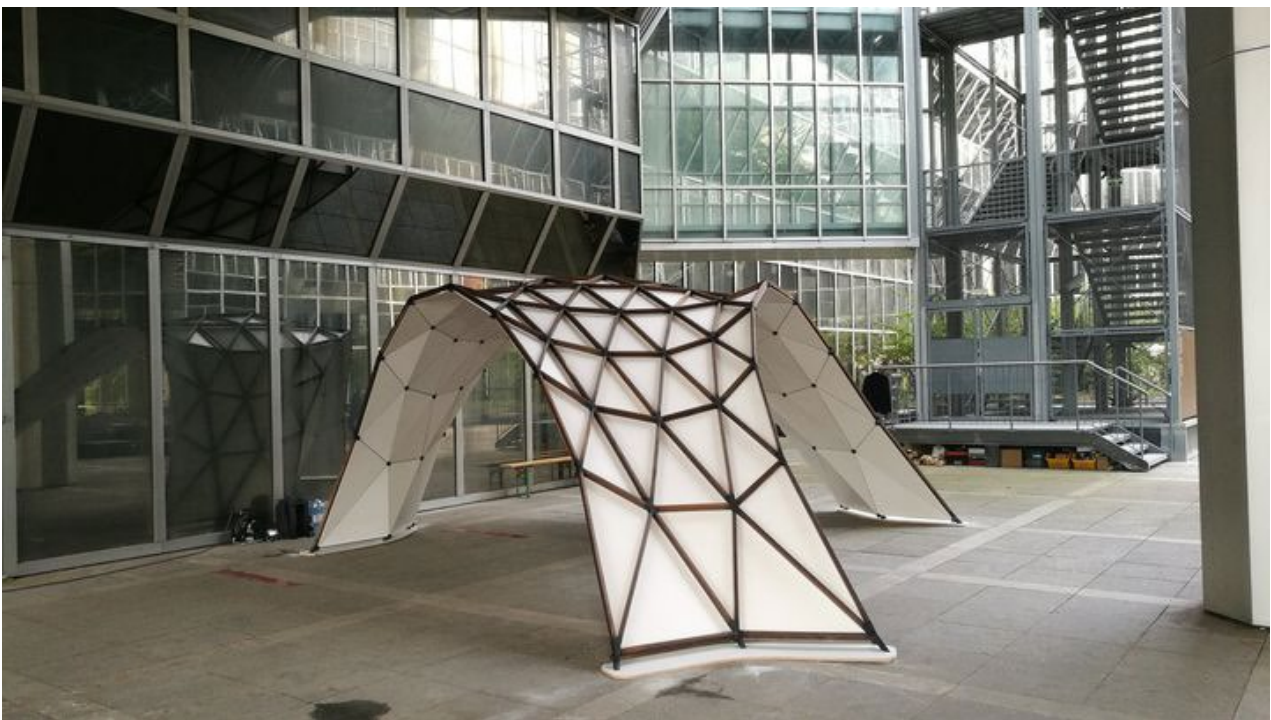


## More than printing with sand

3D printing in architecture does not just mean printing with sand. In China, **the world's longest 3D-printed concrete bridge** is already accessible for use; in Amsterdam, **the longest 3D-printed steel bridge** brings pedestrians across a canal; and in Rotterdam, **the first printed pedestrian bridge** constructed of fiber-reinforced polymer has been realized.

But not only bridges are being printed. Austrian precast manufacturer **Overtec** has already developed concrete 3D printing of wall panels to series production readiness. Functionally, Overtec's 3D-printed products score points for durability and fire protection, while visually the design is impressive: structure and printed image provide unexpected visual effects.

Furthermore, ceramics are now 3D printed as well and combined printed materials are a reality, such as the **Opti-Knot-3D Pavilion** by civil engineer **Benjamin Kromoser** and architect **Thomas Pachner** together with **Patonic**, a company based in Grieskirchen, Austria. The pavilion is a several-meter-high prototype made of oak wood rods and 3D-printed cornstarch knots, plywood panels and screws illustrating the future of construction. Both customized and recyclable.



Opti-Knot-3D Pavillon by Benjamin Kromoser, Thomas Pachner und Patonic; Credits: [www.patonic.com](http://www.patonic.com)

As far as composite materials are concerned, Christine Bärnthaler firmly believes that there will be a lot more to come in the next few years:

*“There are certain developments that we still have to wait for. Depending on demand and focus, new technologies will emerge accordingly. One thing is clear: development is progressing and there is potential.”*





She regards this development as an unstoppable process in which different disciplines are not excluding each other, and each discipline is allowed to exist alongside the other. A cross-disciplinary network has also been established in Austria over the past few years. Numerous possibilities are arising, both in the field of material development and in business models:

*”Design and production will be purchased, but the material is rented. After the contract expires, it will be returned. This allows the material to be recycled and reused.”*

## Unlimited variety of shapes

Georg Grasser, founder of **Incremental 3D** and Senior Scientist at the University of Innsbruck, researched a process for applying 3D concrete printing in building construction with his team, students and **Baumit**, a manufacturer of building materials. In 2019, he and his research partners were given the opportunity to design a temporary ceremonial pavilion made of 3D-printed concrete to mark the 350th anniversary of the University of Innsbruck.

According to Georg Grasser, this project also served as a test as to whether concrete printing is actually suitable for the construction industry. The pavilion consisted of 47 individual parts that were mainly hollow. Material was only applied where it was statically necessary.

In 2018, Incremental 3D already worked with designer **Philipp Aduatz** to create design objects such as a carbon reinforced chaiselongue and small furniture series which were also 3D printed from concrete.



Digital Chaiselongue 2018: Design: [www.philippaduat.com](http://www.philippaduat.com); Photo: Paris Tsitsos; Produktion: [www.incremental3d.eu](http://www.incremental3d.eu)



In 2019, the 3D printing specialists teamed up again with Philipp Aduatz to implement another concrete-printed small series. The benches had spans of up to 2.50 m and weighed more than 500 kilograms. The importance of composite materials becomes particularly clear in this case, because the benches cannot be fabricated exclusively using the concrete printing process - for structural reasons, the benches were reinforced with glass fibers. From a creative point of view, Georg Grasser and his colleagues prove that a lot more can be achieved than merely applying layers horizontally in an additive manner - with new technology, there are no limits to the variety of shapes.

The Upper Austrian company **uniQum**, which prints furniture and objects for outdoor use, has also specialized in 3D concrete printing. It supports architects, planners and designers to create modern outdoor spaces and produces and/or designs in 3D concrete.

## Challenges for 3D printing in construction

Thomas Gruber is responsible for the implementation of plastic and metal 3D printing at **Doka**. Doka is part of the Umdasch Group, which uses 3D printing and robotics technology in its various divisions.

*„The history of using 3D printing technology at Doka and in the Umdasch Group is a very recent one. We started testing this technology at Doka about three years ago.“ Thomas Gruber considers this to be a very courageous step, given that for the company there was no concrete ‚use case‘ underlying this commitment. Although they were sure that they would need this new technology at some point, the timing was still unclear at the time. „It was important for us to be ready to use the technology on Day X,“ says Thomas Gruber in retrospect.*

Doka uses filament printers for building models, among other things. Two and a half years ago, the company invested in a plastic printer - the raw material, a plastic powder, is melted with a laser. Shortly thereafter, a metal printing system was also purchased. The highly complex metal printing process remains a major challenge: In this case, the base material is also a powder, which is likewise melted by a laser. However, the temperature required to melt steel, aluminum or titanium powder must be much higher than for plastic printing.

At Doka, printed plastics primarily serve as prototypes in product development. For developers, the physical model provides a significant advantage over purely digital models because, for instance, functional tests can be carried out on the prototype and solutions can also be discussed realistically with colleagues. Physical models allow iteration loops to be carried out more quickly, which minimizes development cycles enormously, and formwork planning can also be carried out more quickly and easily.

Umdasch Ventures also holds shares in **Contour Crafting Corporation**. Behind this is a mobile 3D construction printing robot that realizes turnkey houses or other objects directly and fully automated on site. These robots reduce the construction time of buildings to a few days or even hours. The New York start-up **SQ4D** recently proved this to be possible.





3D-Druck von Schalung: Pilotprojekt von Doka und voxeljet im Rahmen des Projekts  
“Neubau Sächsische Aufbaubank (SAB), Leipzig”; Credits: doka

All three experts agree: The big challenge to be overcome is the question of business models for such projects. However, the continuing development of suitable materials and composites are also an essential factor. In addition, permits must be obtained for the process as well as for the materials. Moreover, the demand for more sustainable and resource-saving construction in the future is an essential aspect in the further development of 3D printing in the construction and architecture industry.

## WE ARE SO additive (VIDEO)

Watch the video summary of the expert's discussion during the event WE ARE SO additive, which took place in October 2020 within the framework of the project COCO4CCI - funded with support from the European Commission.

As part of the WE ARE SO talk series, the City of Media Arts Network in Linz regularly invites people to get to know and discuss digital and creative industry trends together. The format is dedicated to one topic from three different perspectives: in the intro session, an expert gives an introduction to the topic, then a creative professional talks about his or her experiences, and finally there are insights from the perspective of a corporate. The goal of WE ARE SO additive was to bring Creatives, Architects and AVM from the construction industry together and inspire them for new production methods and collaborations.

 [www.bit.ly/AdditiveInArchitecture](http://www.bit.ly/AdditiveInArchitecture)



Read the german translation here: BAUEN MIT DEM 3D-DRUCKER

[www.creativeregion.org/2021/02/bauen-mit-dem-3d-drucker](http://www.creativeregion.org/2021/02/bauen-mit-dem-3d-drucker)





## ADDITIONAL LINKS

### Studios/Experts

Mamou-Mani Ltd Architects: [www.mamou-mani.com](http://www.mamou-mani.com)

Studio Precht: [www.precht.at](http://www.precht.at)

Ofroom: [www.ofroom.net](http://www.ofroom.net)

Overtec: [www.overtec.com](http://www.overtec.com)

Patonic: [www.patonic.com](http://www.patonic.com)

Incremental 3D: [www.incremental3d.eu](http://www.incremental3d.eu)

Baunit - Bauminator: [www.baunit.at/bauminator](http://www.baunit.at/bauminator)

Philipp Aduatz: [www.philippaduatzen.com](http://www.philippaduatzen.com)

Uniquum: [www.uniquum.com](http://www.uniquum.com)

Doka: [www.doka.com](http://www.doka.com)

Contour Crafting 3D: [www.contourcrafting.com](http://www.contourcrafting.com)

SQ4D: [www.sq4d.com](http://www.sq4d.com)

### Projects

The Sandwaves: [www.mamou-mani.com/project/sandwaves](http://www.mamou-mani.com/project/sandwaves)

World's Largest 3D-Printed Concrete Pedestrian Bridge Completed in China:  
[www.archdaily.com/909534/worlds-largest-3d-printed-concrete-pedestrian-bridge-completed-in-china](http://www.archdaily.com/909534/worlds-largest-3d-printed-concrete-pedestrian-bridge-completed-in-china)

MX3D-Bridge Amsterdam: [www.mx3d.com/projects/mx3d-bridge](http://www.mx3d.com/projects/mx3d-bridge)

Rotterdam Bridge: [www.3dprintingindustry.com/news/sustainable-3d-printed-foot-bridge-to-be-built-in-rotterdam-using-dsm-thermoplastics-173243](http://www.3dprintingindustry.com/news/sustainable-3d-printed-foot-bridge-to-be-built-in-rotterdam-using-dsm-thermoplastics-173243)

Opti-Knot-3D Pavilion: [www.viennadesignweek.at/archiv/2019/opti-knot-3-d-pavillon](http://www.viennadesignweek.at/archiv/2019/opti-knot-3-d-pavillon)

Digital Chaiselongue 2018: [www.youtube.com/watch?v=z8CVQCpAVcM](http://www.youtube.com/watch?v=z8CVQCpAVcM)



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