3DLight_OnSite

3D concrete printing enters the next stage of development

More sustainable, more lightweight, more agile

"3DLight_OnSite" is the name of a research project launched by ZÜBLIN together with other companies, universities and research institutes. The exciting thing about the innovation project is that it combines several trends of vital importance to the industry, such as sustainability, construction robotics and concrete printing.

The STRABAG Group has already employed concrete printing in a pioneering project in Hausleiten, Lower Austria. But 3DLight_OnSite goes even further, taking 3D concrete printing to a new level of development through a novel and innovative concept. The STRABAG Group and its project partners are working systematically on technological progress in order to optimally utilise the economic and environmental potential of 3D construction printing.

3DLight_OnSite is funded by the German Ministry for Economic Affairs and Climate Action and forms part of the Lightweight Construction Technology Transfer programme. More information is available in the ministry's Leichtbauatlas, an interactive portal which illustrates the lightweight-related expertise in Germany.

1 Mobile 3D concrete printing robots can lay walls directly on the construction site. © STRABAG

Why is the project called 3DLight_OnSite?

Quite simple.

3D = 3D concrete printing
Light = structurally optimised lightweight concrete walls
OnSite = production directly on site using mobile robot

Systematic digitalisation and sustainability go hand in hand

The conventional construction process for structural works is not very digitalised. STRABAG's goal is to change that and to develop a continuous digital chain that goes from planning and design all the way to construction. With its systematically digitalised manufacturing technology, 3DLight_OnSite addresses relevant topics for the construction of tomorrow. But digitalisation not only ensures greater efficiency and sustainability in the construction process. Another important factor is the possible reuse of existing building materials in the spirit of urban mining. The use of digital manufacturing methods makes it easier to track the materials used, enabling the sustainable dismantling of individual parts to give them a second life in new building projects.

All good things come in threes – so, too, in concrete printing

The name of the 3DLight_OnSite research project refers to its focus on three factors that contribute significantly to the further development of concrete printing:

- The project is about 3D printing, though the process is not carried out by stationary printers as in the past, for example in the prefabrication of printed elements, but by individually mobile robots. Flexible, agile, precise.
- The approach is a lightweight construction method inspired by bionics, which provides for concrete only where it really makes sense and where it is necessary from a structural point of view – at almost the same cost as commercially available in-situ concrete solutions. Moreover, the method uses newly developed types of concrete produced in an optimised pressure process that can reduce the carbon footprint by up to 50 % compared to conventional concrete walls.
- The mobile printing robots can be used flexibly and efficiently directly on the construction site, where they obtain the 3D print data directly and seamlessly from the BIM model (Building Information Modelling).

UP TO

50 %

LESS CO_2 THAN WITH CONVENTIONALLY BUILT WALLS

Additive manufacturing becomes more flexible

How flexible printing robots will work in the future? See for yourself!

With the 3DLight_OnSite research project, STRABAG and its project partners are developing the prototype of a mobile construction site printer as the first-ever combination of caterpillar track vehicle and industrial robot with a special nozzle head. The printer unit will be powered by a drive train that allows it to be moved flexibly wherever needed. The aim is for the robot to print walls in-situ, i.e. directly on the construction site.

The new technology offers many important advantages over conventional printing systems, which are usually less flexible and scalable only to a limited extent. Gantry cranes capable of printing houses already exist, but the size of the gantry, i.e. the scaffolding on which the printer is mounted, is limited. Buildings printed in this way can usually be no more than two storeys tall. Then there is another complicating factor: the higher the printing gantry, the higher the forces that need to be withstood during the printing operations.

With 3DLight_OnSite, the focus is on several mobile robots. Each of the units performs simple tasks individually, but all are controlled together by a more complex production system. The advantage: additive manufacturing, i.e. 3D printing, becomes faster, cheaper, more robust and more scalable.

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Inspired by nature: lightweight construction like a honeycomb

An important part of the research project focuses on the lightweight construction of wall structures. Additive manufacturing works with structures similar to honeycombs, which have maximum stability with very low material consumption. This is where research can learn from nature. The wall shell of a building project is constructed from printable mortar of different strengths and then filled with a foam concrete that serves as insulation and soundproofing.

The special structure of the wall elements significantly reduces material consumption in contrast to solid blocks, which in turn has a very positive effect on the carbon footprint of the overall structure. In terms of carbon emissions, concrete production is, after steel production, the second most carbon-intensive production method in the building process, responsible for a large part of the emissions that are generated during construction. So we have an important lever here for reducing carbon emissions and protecting the climate. 3DLight_OnSite wants to use this lever.

1 Illustration of lightweight construction

Almost ready for volume production – research is in full swing

The technology of additive manufacturing has long outgrown its infancy. Universities and industry have been researching the topic extensively for the past five years or so, and the new process is now fit for large-scale production. On the construction site of the future, for example, many small printing robots will work together using swarm intelligence to complete the structural works of a building in a largely automated fashion.

Interdisciplinary teamwork is crucial for success

3DLight_OnSite is driven by the cooperation of several key players who contribute their expert knowledge in agile working groups called “scrum teams”. Depending on the task at hand, these teams are repeatedly put together in new expert constellations. This makes it possible to reliably coordinate the complex interactions in 3D concrete printing between material, machine and process.

Presentation of the research partners

TU Berlin handles the material development

Hochschule Bochum contributes the architects’ perspective at the component level

Ed. Züblin AG expertly combines all activities in an end-to-end digital construction process

KADIA Produktion GmbH + Co. weds the digital platform with industrial robots and nozzlesn

ISG Industrielle Steuerungstechnik GmbH programs the control system for 3D printing on the construction site

Contact/Project Manager

Alexander Caran
STRABAG Innovation & Digitalisation
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