

# Automated Concrete Reinforcement

Student



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**Initial Situation:** Current advances in 3D concrete printing (3DCP) have shown that architectural elements and houses can be built with this new technology. However, structural concrete elements can hardly be produced due to the inherent brittleness of concrete. Therefore, metallic reinforcement needs to be integrated. Currently, various reinforcement strategies are being explored. One promising approach is the addition of a steel cable during the printing process.

**Approach / Technology:** At ETH Zürich, a 3DCP system has been developed. For this setup, an automated concrete reinforcement system (ACR) needs to be developed. This system feeds a steel cable into the printing filament. The cable can either be placed between the layers or extruded with the concrete. This approach reinforces the concrete filament in the direction of printing. After the scope of the project is defined, a literature review shows existing solutions and their limitations. Afterwards, different functional solutions are developed and listed in a morphological box. Out of these options, four different solutions are sketched, described and analysed. The solution with the highest score is then developed further. Before designing the final prototype, preliminary tests were performed. These test results showed that the solution needs further simplification.

**Result:** Figure 2 shows the final system. The cable spool is attached to the third axis of the robot to reduce the weight close to the nozzle. From there, the cable runs through the yellow tube to the feeder, which feeds the cable at the same speed as the nozzle is moving. The cable is then guided into the nozzle, where it is combined with the concrete and extruded together with the concrete. First experimental tests have shown that the system performs well. It is recommended to do further testing. In a further step, the system can be upgraded (e.g. to feed larger cables), or a new system with additional functionalities can be manufactured.

Figure 1: Concrete 3D printer at the ETH Zürich with printed structures in the background  
Own presentment



Figure 2: Concrete 3D printer with ACR  
Own presentment

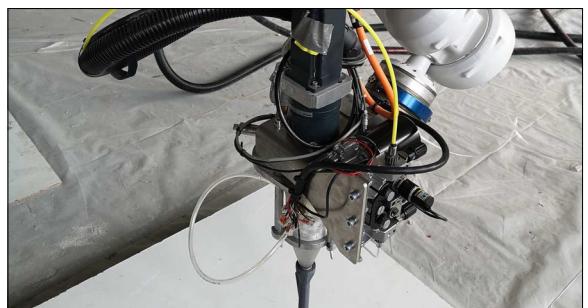


Figure 3: 3D printing test  
Own presentment



Examiner

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Subject Area

Innovation in Products,  
Processes and  
Materials - Industrial  
Technologies

Project Partner

Institute of Technology  
in Architecture,  
Institute for Structural  
Engineering, ETH,  
Zürich, ZH