# ROBOT BASED TECHNOLOGY FOR THE PRODUCTION OF NOVEL RESOURCE-SAVING AND COST-EFFICIENT TEXTILE REINFORCEMENTS FOR DIRECT FURTHER PROCESSING INTO PREFABRICATED PARTS

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## ABSTRACT

Steel reinforced concrete is the predominantly used construction material in civil engineering.

However, besides the numerous advantages of steel regarding the absorption of tensile forces in a construction, steel reinforced concrete exhibits the disadvantage of corrosion. Therefore, concrete coverings that measure several centimeters in thickness must be added to the steel reinforcement.

A promising approach to prevent the reinforcement from corrosion is provided by the application of carbon fibers as textile reinforcing material. This so-called Textile Concrete developed at TU Dresden consists of a grid array of carbon fiber rovings that are embedded into a polymeric matrix. Textile reinforcing structures are available on the market either as rolls with a width of 2.5 m or as small mats of 5 x 1.2 m.

The manufacturing of precast concrete parts within an automated production process poses fundamentally different requirements to components and the manufacturing method. In the manual production of prefabricated parts made of carbon concrete, door and window cut-outs of the textile reinforcement must be manually executed , resulting in tremendous efforts and staff costs. Moreover, overlapping areas of reinforcement, door and window cut-outs lead to a waste rate of 35%. The laying path of the rovings is adapted to the load path of prefabricated parts, thus saving material and production time. To successfully introduce and establish this process within the market for prefabricated carbon elements, the development of a new technology for the automated production of textile reinforcements, their automated integration into the formwork and subsequent concreting is essential.

Within a constructive-technological development process, a concept for a circuit process tailored to precasting plants was generated and realized. Key technologies were elaborated, e.g. a 6-axis-robot with a robot gripper including yarn delivery, a coating unit and a tension controller, which lays the coated yarn onto a modular clamping frame in the shape of a grid consisting of impregnated and pretensioned yarns. A continuous process chain is the basis for the cost-efficient market launch of this innovative technology. An important step towards achieving this goal was the creation of a software for the efficient, automated program generation for laying robots. Even batch sizes of one, which occurs commonly in precasting plants, can be implemented. Previous results form a solid foundation to further develop this novel, automated yarn laying method for the manufacturing of textile reinforcement structures to enable their successful market launch in the prefabrication sector.