Adaptive modularized constructions made in a flux

Quality-assured flow production of lightweight UHPC rod elements using artificial neural networks

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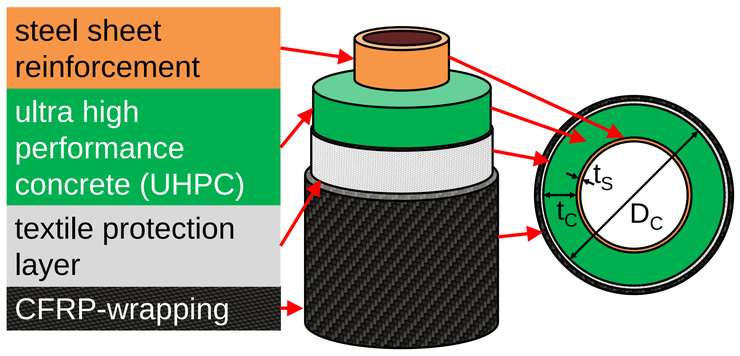
Motivation: Flow Production of Lightweight Rod Elements for Trusses

Faster construction requires components that can be produced in flow production processes.

Rod shaped hollow elements (HUSC-Elements) made of ultra high performance concrete (UHPC), steel and carbon fiber reinforced polymers enable fast production processes with in-line quality assurance.

HUSC-Elements



Typical dimensions:

thickness of steel sheet	t_S	=	4,0	mm
thickness of concrete	t_C	=	30,0	mm
diameter of concrete	D_C	=	360,0	mm

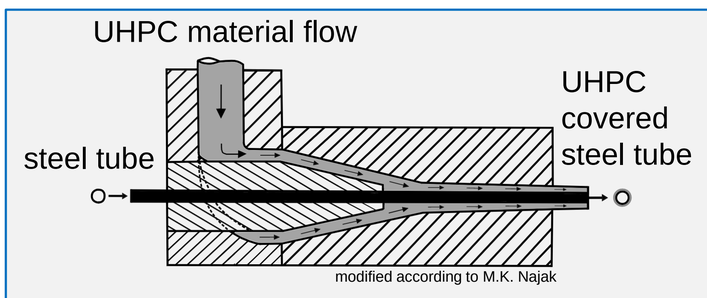
Form follows function – Benefits of the HUSC-Elements

- lightweight elements
- high buckling stability
- material and shape adaptable to a wide range of applications
- hollow space inside can be used for post tensioning and installations
- resource-efficient by material oriented design

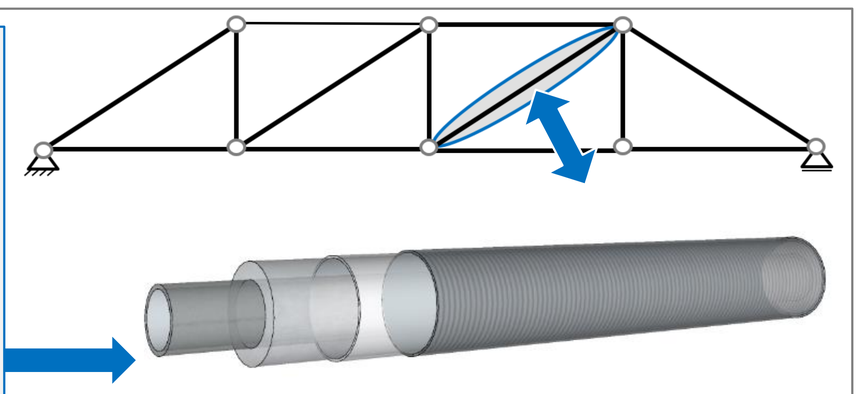
Methods: Crosshead Extrusion and Artificial Intelligence

Aims

- modular frameworks for fast building and fast assembly on the construction site
- more efficient use of resources by high performance elements
- less waste and higher quality by extended quality assurance using artificial neural networks

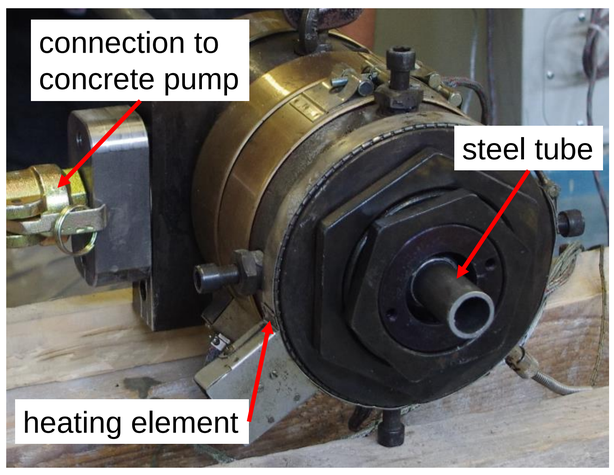


Extrusion process of HUSC-Elements
- continuous, automatic process
- no formwork needed
- no bending & relocating of steel reinforcement
- high dimensional accuracy
- data driven, self-learning quality assurance
- fast



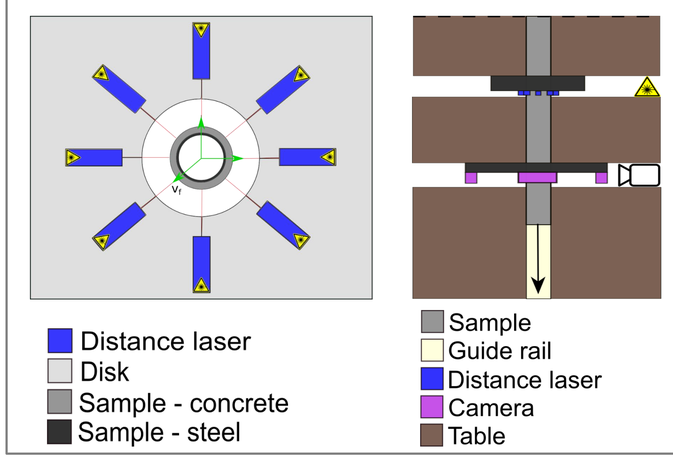
Shape and material optimized **HUSC-Elements** as basic element for **trusses**

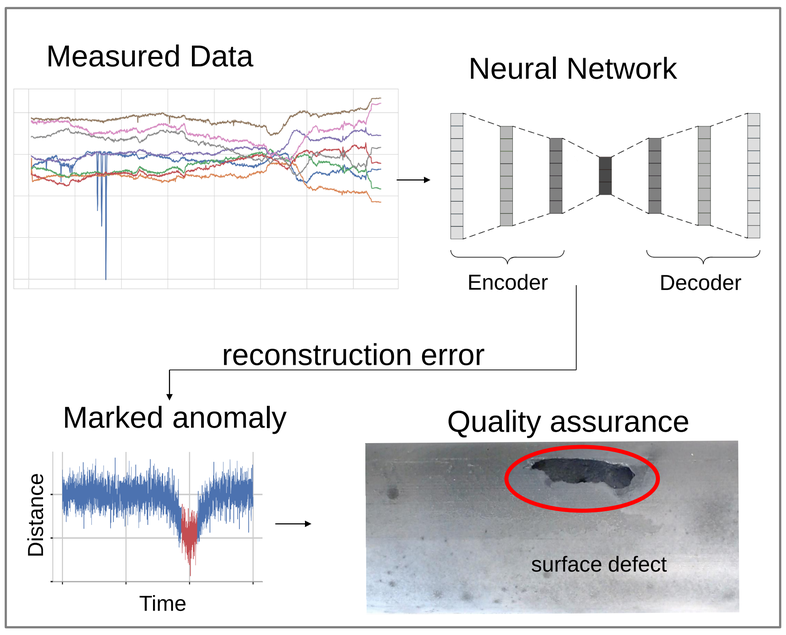
UHPC Crosshead Extrusion



crosshead extrusion device in lab scale

Quality monitoring using timeseries and image data using camera systems
- Distance lasers
- Cameras (Video, Stereo, Infrared)





Publications

[1] Markowski, J.; Lohaus L.: Winding Reinforced UHPC Sandwich Structures for Lightweight Jackets for Offshore Megastructures. In: Journal of Physics: Conference Series 1356 – Proc. of EERA Deep Wind Conf., 2019

[2] Markowski J.; Lohaus L. .: Innovatives Bewehrungskonzept für leichte Stützen aus ultra-hochfestem Beton. In. Lohaus, L.; Haist, M., Marx S. (Hrsg.): Beiträge zur 7. DAfStb-Jahrestagung mit 60. Forschungskolloquium, 28./29.10.20219 in Hannover-Institutionelles Repositorium der Leibniz Universität Hannover, 2019, S. 183-195.

[3] Penner, N.; Grießmann, T., Rolfes R.: Monitoring of suction bucket jackets for offshore wind turbines: Dynamic load bearing behavior and modelling. In: Marine Structures 72, 2020.

[4] Tritschel F.F.; Markowski J.: Penner, N. Rolfes, R. Lohaus L.; Haist M.: KI-gestützte Qualitätssicherung für die Fließfertigung von UHFB-Stabelementen. Beton- und Stahlbetonbau 116, Sonderheft Schneller bauen S2, September 2021, S. 34-41.

[5] Lohaus, L.; Rolfes, R.: Qualitätsgesicherte Fließfertigung leichter UHFB-Stabelemente mittels Künstlicher Neuronaler Netze. BetonWerk International Nr. 2, 2021, S. 18

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