STATIK &
DYNAMIK
PROF. DR. SAUER

RUB

Master Thesis

Numerical Simulation and Data Generation for AI-based Structural Behavior Prediction of Reinforced and Prestressed Concrete Structures

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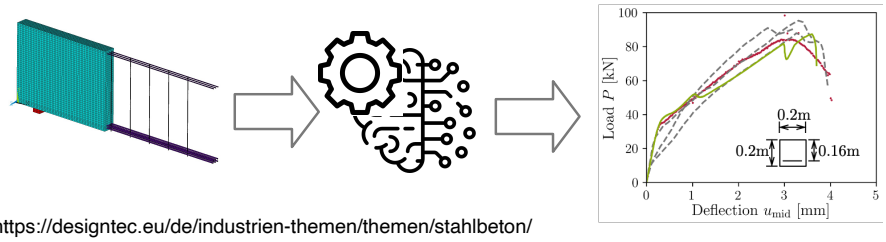

https://designtec.eu/de/industrien-themen/themen/stahlbeton/

Background: In civil engineering, the reliable prediction of the structural behavior of reinforced and prestressed concrete structures is a central task, for example in design, safety assessment, and structural optimization. Artificial intelligence, in particular Transformer models, offers new possibilities for predicting complex load–deformation relationships and crack development. Due to the wide variety of possible geometries, reinforcement layouts, material properties, and loading scenarios, experimental investigations alone are often time-consuming, costly, or practically infeasible for data generation. Numerical simulations, particularly finite element (FE) models, enable systematic and scalable data generation that covers all relevant geometric, material, and loading parameters.

Task: The goal of this work is to systematically define the relevant input and output parameters as well as the design space for reinforced and prestressed concrete members, providing a solid foundation for AI-based structural behavior predictions. Building on this, FE simulations using the open-source software Kratos will be performed to generate extensive and diverse training data. The FE model will first be validated against existing experimental data to ensure the reliability of the simulation results. Subsequently, additional FE simulations will be conducted using targeted sampling strategies for various combinations of geometry, material, reinforcement, prestressing, and loading scenarios, and evaluated for multiple time step sizes and mesh resolutions.

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