Technical University of Denmark

Popular science summary of the PhD thesis

PhD student	Zuffain Hussan
Title of the PhD thesis	Structural Optimization and Performance of 3D-Printed Thermoset Formwork for Concrete Casting
PhD school/Department	DTU Construct

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology:

The construction industry is undergoing a significant transformation with the advent of 3D-printed materials, particularly in the realm of formwork for concrete casting. Traditional formworks are often labor-intensive, costly, and struggle with complex shapes. This PhD thesis explores the use of 3D-printed thermoset materials to address these challenges, offering a more adaptable and cost-effective solution. 3D-printed thermoset materials are characterized by their strong interlayer bonding and nearly isotropic properties. These qualities provide significant advantages in applications where interlayer stiffness is critical and delamination poses a concern, making them well-suited for complex formwork designs. The research introduces optimization methods, such as the Ground Structure Method (GSM) and the novel Maximum Displacement Technique (MDT), to improve the structural geometry towards enhancing the stability and efficiency of the formwork. These techniques significantly reduce displacements during concrete casting, ensuring the formwork maintains its shape and integrity. Through rigorous testing, including material characterization, water pressure tests, concrete load testing, and long-term stability assessments, the research confirms the enhanced performance of 3D-printed thermoset formworks. The research demonstrates the practical effectiveness of these innovations in real-world scenarios, with complex column formworks, including circular, arch, hourglass and twin-funnel shapes, successfully tested and showing stable performance and potential for reuse. This groundbreaking work paves the way for the widespread adoption of 3D-printed formwork in the construction industry, suggesting that these materials and optimization techniques can lead to more efficient, sustainable, and cost-effective construction practices.

Please email the summary to the PhD secretary at the department