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**DOCTOR OF ENGINEERING SCIENCES**

of **Ramak Hossein Abadi**

The public defense will take place on **Wednesday 18<sup>th</sup> March 2026 at 5pm** in room **I.0.03** (Building I, VUB Main Campus)

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**EXPERIMENTAL AND NUMERICAL INVESTIGATION OF THE FORMING BEHAVIOR OF FLAX/PP THERMOPLASTIC COMPOSITES DURING THERMOSTAMPING**

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## Abstract of the PhD research

Natural fibers, such as flax, can be used in thermoplastics as reinforcement to produce low-cost and environmentally friendly composites for a range of applications. Natural fiber thermoplastic composites offer low specific weight, high strength, acoustic, and thermal insulation. Manufacturing these parts involves techniques like thermostamping, in which the composite is heated above the matrix's melting point and pressed into the desired shape. During thermostamping, the material undergoes multiple deformation mechanisms with in-plane shear and out-of-plane bending being the dominant modes. As a result of the interaction of these mechanisms, the composite part can become susceptible to defects such as wrinkles, highlighting the need to account for them in part and process design.

Despite the fast-growing interest in flax fiber-reinforced thermoplastic composites, their formability behavior has yet to be studied extensively. To address this, a series of experiments targeting key deformation mechanisms, including in-plane shear and out-of-plane bending, were conducted to analyze the material's response under various thermostamping conditions. The influence of reinforcement structures on these deformation mechanisms was also examined by comparing the spread-tow woven and UD cross-ply composite laminates. Complementary stamp-forming tests were carried out to evaluate the material response under conditions representative of the process.

The experimental results form a foundation for developing models that capture the nonlinear, temperature- and rate-dependent behavior of these composites. By integrating experimental observations with numerical simulations, this research aims to establish a validated framework for simulating the thermostamping process of thermoplastic composites. The proposed framework enables the optimization of the thermostamping process to minimize defects and improve manufacturing quality. Additionally, the performed experiments provide valuable reference data to support future research and the development of sustainable composite manufacturing technologies.