# Investigation on the Flexural Behavior of Reinforced UHPC T-Beams with Different Tensile Strain-Hardening Properties of Base Materials

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## Abstract

Ultrahigh performance concrete (UHPC) has been broadly endorsed for many applications in the construction industry due to its superior mechanical properties and excellent durability. Nevertheless, UHPC utilization as full and large structural components is still limited due to the lack of standardized design guidelines and consistent mechanical models. This study presents a numerical investigation on the flexural behavior of UHPC T-beams under the influence of the tensile grade of UHPC, and the reinforcement ratio. The behavior is studied under three conditions relating the UHPC tensile strain to the reinforcement yielding strain. That is, UHPC peak tensile strain is smaller than, equal to, or larger than the yielding strain of the rebar, reflecting the sequence of crack localization and yielding of rebars. Each condition is examined against a reinforcement ratio ranging from low to high ratio. The nonlinear finite element modeling approach is validated by experimental data available in the literature.

**Keywords:** UHPC; flexural behavior; strain-hardening; multiple cracking; peak strain.

## 1 Introduction

Ultrahigh performance concrete (UHPC) is one of the state-of-the-art construction materials developed in recent decades that demonstrate outstanding mechanical properties, including compressive strength of more than 150MPa, sustained post-cracking tensile strength and pronounced durability [1,2] . UHPC has attracted worldwide attention from researchers for its high potentials in the construction sector. Even so, its approval as full and large structural components is still limited by several constraints including a lack of consistent and practical design models, low knowledge of the production procedures and quality control, demand for rigorous curing regimes, and the high production cost [3,4]

The inconsistencies and complications in the design models are attributed to the sensitivity of UHPC to

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