

---

## ***ABSTRACT***

The thesis deals with the characterization of the failure of steel fiber reinforced concrete (SFRC) in tension and shear, on the material level, and the determination of parameters that represent the toughness in these two modes of failure. Tests have been performed on large-scale beams failing under shear failure, which have been analyzed using existing design code formulas. The toughness parameters determined from the material are used in the design against such failure.

The uniaxial tensile behavior of SFRC is characterized using notched cylinders of normal and high strength concretes, with and without steel fibers. The methodology is also extended to cores extracted from large elements. Results are used to define toughness parameters and equivalent post-peak strengths to be used for representing the material behavior and for possible structural design. Furthermore, a parametric study considering different test variables and specimen shape is carried out in order to define a reliable test configuration. The observed modes of failure are analyzed and the stress-crack width response is evaluated. Also, a characteristic stress-crack width response is proposed for structural analysis and design. The uniaxial tension behavior is also compared with that of flexural and splitting-tension.

The shear failure is studied using the direct shear push-off test configuration, in normal and high strength concretes with and without steel fibers. The mode of failure and the stress-slip and stress-crack opening responses are analyzed. Toughness parameters and equivalent shear strengths based on the test results are defined for structural design.

In order to provide results for validating the use of steel fibers as shear reinforcement and for studying shear failure at the structural level, full-scale tests on rectangular and T-beams were performed. The load-deflection and load-crack width responses are analyzed and compared with results of plain concrete beam tests. The experimentally-obtained results are used to evaluate the applicability of existing design methods for steel fiber reinforced concrete. Furthermore, a proposal for shear design based on the shear stress versus slip relationship from the push-off shear test is presented.