The present research improves the experimental and theoretical knowledge on the behaviour of structural elements made of ultra high performance fibre reinforced concrete (UHPFRC) with ordinary reinforcement.

UHPFRC is a recently developed material with much higher mechanical properties and durability than ordinary concrete. However, it has been used so far in a limited number of structural applications. A better knowledge on the behaviour of UHPFRC in structural members is needed to be able to take advantage of its outstanding properties in structural design.

One of the ways in which the structural efficiency of UHPFRC can be studied is to investigate the improvement in structural performance that is gained by using UHPFRC instead of ordinary concrete in common structural members. As an alternative, new structural shapes and structural concepts can be explored, more adapted to the specific material properties.

The work presented in this thesis focuses on the first approach by considering the behaviour and modelling of UHPFRC structural members loaded in tension and in bending with axial load, and reinforced with ordinary steel reinforcement.

The experimental and theoretical study carried out on tensile members contributes to the understanding of the fundamental mechanisms that control cracking of a tensile member reinforced with both fibres and bars, in service and at ultimate. A numerical model has been developed to solve the differential problem of bond in the presence of strong mechanical non linearity. This model has been used to simulate the main aspects controlling bond in a UHPFRC member. The results obtained with the model help in clarifying the differences between cracking in ordinary concrete and in UHPFRC ties. The model allows identifying the parameters that influence the strength and ductility of the tie and was used to validate simplified assumptions to model the behaviour of UHPFRC ties in service.

The behaviour of columns has been studied with a theoretical and experimental approach. The results of two test series on UHPFRC and HPFRC columns are reported in the thesis. An analytical model has been developed to study the behaviour of a confined concrete member in compression. A numerical model has been implemented to simulate the non linear behaviour of ordinary concrete and UHPFRC columns. The models have been used to simulate test results reported in this thesis or taken from the literature. The numerical model has been used to evaluate the effect of variations of the mechanical behaviour of concrete on the structural behaviour of a column, with or without reinforcement. The results of those parametrical studies help understanding the influence of mechanical properties on structural response.

This thesis contributes to a better understanding of the behaviour of UHPFRC members with ordinary reinforcement. The comparative approach used in the research makes it possible to show the differences between the structural behaviour of ordinary, high strength and fibre reinforced concrete. Indications are also given on the possible ways in which an effective use of UHPFRC in structural members can be achieved.

**Keywords** : Ultra High Performance Fibre Reinforced Concrete, structural members, ordinary reinforcement, bond, tie, column, confinement, buckling, numerical model, analytical model, structural applications.