Summary

Unreinforced masonry structures represent the large part of the existing buildings in many countries. Some of these countries belong to regions were high seismic hazard is present. Due to the high mass of these structures, the seismic action can be the most demanding [104]. If the out-of-plane failure mechanisms of a structure are avoided, the resisting mechanism to horizontal action has to be assured. The distribution of the forces in the resisting elements is dependent on the shear capacity of the media [181] and the failure of these elements is characterized by diagonal tension cracking [16]. These structures may need retrofitting, conservation, safety assessments, etc. For these reasons, the mechanical characterization of the shear modulus and of the tensile strength is necessary. These properties are usually measured using destructive tests that can be incompatible with some structures and are quite expensive.

Therefore, the necessity of a minor destructive test for evaluating the shear modulus and the tensile strength of masonry structures is clear.

To achieve this goal, a new minor destructive test (Shear *FJ* test) was conceived using the flat jack technique. *FEM* analyses were utilized in order to define the best geometrical configuration that was defined considering the destructiveness, costs and effectiveness of each layout. Once the best layout was found, a parametric study of the test was performed giving as result tools to evaluate principal stresses of the sample and a method to measure the shear modulus.

The test method was then designed and successfully applied on five in situ experiments.

Linear and non-linear numerical analyses were performed to analyze the experimental results. In particular, the analyses were performed to understand the ability of the Shear *FJ* test to measure the tensile strength and the shear modulus.

Further tests and the analyses of the results obtained here will give a definitive response to understand the effectiveness of the Shear *FJ* test.