Abstract

This PhD thesis presents a comprehensive investigation into the performance of air lime-based mortar masonry specifically focusing on the in-plane behavior of masonry at large scale. This study aims to address the knowledge gap in the structural applications of air lime-based mortars, which were frequently used before their substitutions with cement-based mortars due to their improved compressive strength. This study begins with a review of key topics related to masonry and air lime mortar properties at various scales both in terms of experimental testing and numerical modelling. Then it proceeds with an analysis of the properties of the materials used in the research: air lime mortars and clay brick units. Following this, the research delves specifically into the mechanical properties of the masonry constituents, in terms of large-scale testing. This includes lateral cyclic pushover tests and vertical shearing tests on masonry walls on deflecting members to evaluate their structural behavior under complex loading conditions.

Numerical modelling techniques, particularly those relevant to industry and based on finite element methods (FEM), are then employed to simulate the large-scale behavior of the masonry. These models are validated against experimental results and used to predict performance and optimize design parameters. Additionally, current code parameters and recommendations are compared to the performance of air lime-based masonry to assess the safety and reliability of standard predictions for masonry design. Key findings highlight the potential ductility of air lime-based mortars and the masonry constructed with them, demonstrating their ability to sustain significant loads while exhibiting deformation characteristics. This indicates their viability for structural applications, particularly in the context of new masonry buildings where the sustainability of materials is becoming increasingly important. The research acknowledges the importance of considering additional aspects of air lime-based mortars, such as the long-term effects of the carbonation process and the benefits of incorporating recycled materials into their construction. By addressing critical research areas in the context of air lime mortars in full scale masonry applications, this thesis aims to rediscover the potentiality of air lime-based mortar masonry, ensuring its continued use in modern building practices and contributing to more sustainable and resilient construction methods.