

Department	School of Engineering and the Built Environment
Supervisors	Dr Aikaterini Marinelli and Dr Daniel Barreto
Project Title	From 3D Digital Documentation to Structural interventions for historic masonry structures

PROJECT DESCRIPTION

Engineering problems related to conservation and restoration of Cultural Heritage are attracting increasing attention by researchers, offering opportunities for novel research and industry collaborations. Scotland's historic environment is an essential part of its cultural background and economy but the effects of ageing, environmental conditions and past natural hazards have caused significant degradation, urging for action (Hyslop et al., 2006).

The development of digital technologies, such as terrestrial laser scanning, has already helped produce accurate representations of structures with applications in conservation, monitoring and Building Information Modelling (BIM) projects. The exploitability of laser scanning outputs, in the form of point clouds, is however still challenging though with respect to application for structural analysis of the built heritage. Recent developments refer to a variety of approaches for the reduction of 3D point clouds of complex structures (D'Altri et al., 2018) into models making use of advanced non-linear computational formulations based on the Finite Element Method (FEM) and Discrete Element Method (DEM), to facilitate and optimise capturing the mechanical behaviour of historic masonry structures. This provides additional information for decision makers to ensure the maintenance, adaptability and resilience of existing masonry structures.

The aim of this PhD is to explore theoretical and procedural options for the development of highly accurate numerical models for structural purposes, linking 3D point cloud data to detailed modelling of masonry constructions. This innovative approach will incorporate current structural pathology and consider targeted on-site sensor measurements, to obtain semi-automated suggestions for future interventions. The outcome of this research is anticipated to offer an optimised decision-making route for structural interventions, reflecting the needs of a range of commonly encountered structural typologies and problems (Marinelli et al., 2019), with direct applicability to historic masonry structures in Scotland. It will revolutionise practice for directly benefitted external stakeholders, especially those responsible for the care of masonry structures of significant heritage value, by informing the design, improving the structural monitoring and leading to targeted interventions as needed.

Prospective applicants are encouraged to contact the Supervisor before submitting their applications. Applications should make it clear the project you are applying for and the name of the supervisors.

Academic qualifications

A first degree (at least a 2.1) ideally in Civil Engineering, with emphasis on Structures and Structural Mechanics, with a good fundamental knowledge of a) Structural Analysis, b) Mechanics of Materials and c) Computational Mechanics.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. [Full details of the University's policy](#) are available online.

Essential attributes:

- Experience of fundamental reality capture technologies and their use in engineering
- Competent in Computational Mechanics and the use of programming languages
- Knowledge of Structural engineering with applications on Masonry structures

- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Indicative Bibliography	<p>D'ALTRI, A. M., MILANI, G., DE MIRANDA, S., CASTELLAZZI, G. & SARHOSIS, V. 2018. Stability analysis of leaning historic masonry structures. <i>Automation in Construction</i>, 92, 199-213.</p> <p>HYSLOP, E. K., MCMILLAN, A. A. & MAXWELL, I. 2006. <i>Stone in Scotland</i>, Paris, UNESCO Publishing.</p> <p>MARINELLI, A., SANTA, S., SPILIOPOULOS, A. & DASIOU, M. E. 2019. Optimizing strengthening interventions on historic masonry walls: an experimental study. <i>Procedia Structural Integrity</i>, 18, 245-254.</p>
Enquiries	For informal enquiries about this PhD project, please contact Dr Aikaterini Marinelli: A.Marinelli@napier.ac.uk
Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process