



POLITECNICO
DI TORINO

Honors thesis

Master in Architecture Heritage Preservation and
Enhancement

Abstract

**3D models for seismic vulnerability assessment
of historical churches.
The case study of Sant'Andrea in Campi, Norcia.**

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by

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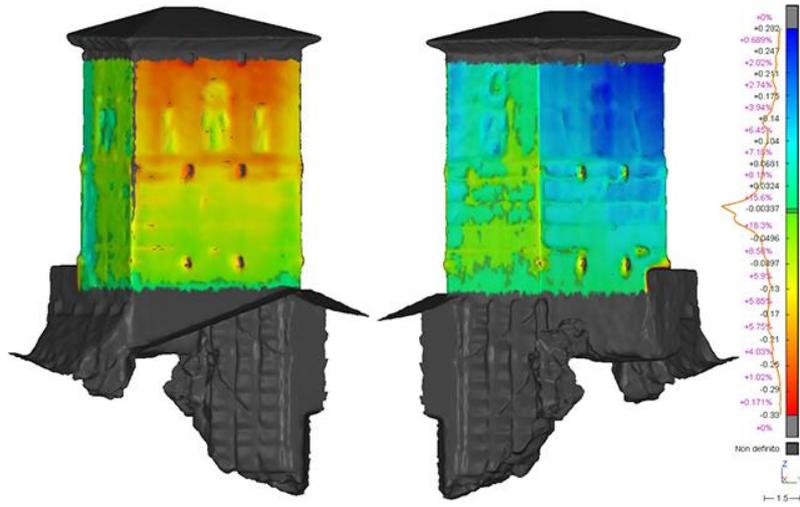
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Earthquakes are catastrophic events that strongly affect historic centers and cultural heritage, as these are particularly vulnerable. Italy is a country with high seismic hazard. Here, churches are a type of historical buildings particularly widespread and also exposed to risk of seismic consequences. The PCM's directive of February 9th 2011, which is referred to in this thesis, outlines the steps that lead to the implementation of a seismic prevention plan. This plan is based on an important level of knowledge, schematic but critically well-founded, so as to be suitable for a territorial vision of churches at seismic hazard. The thesis' aim is to acquire, in a reasonably short time, documentation about the safety level of these buildings.

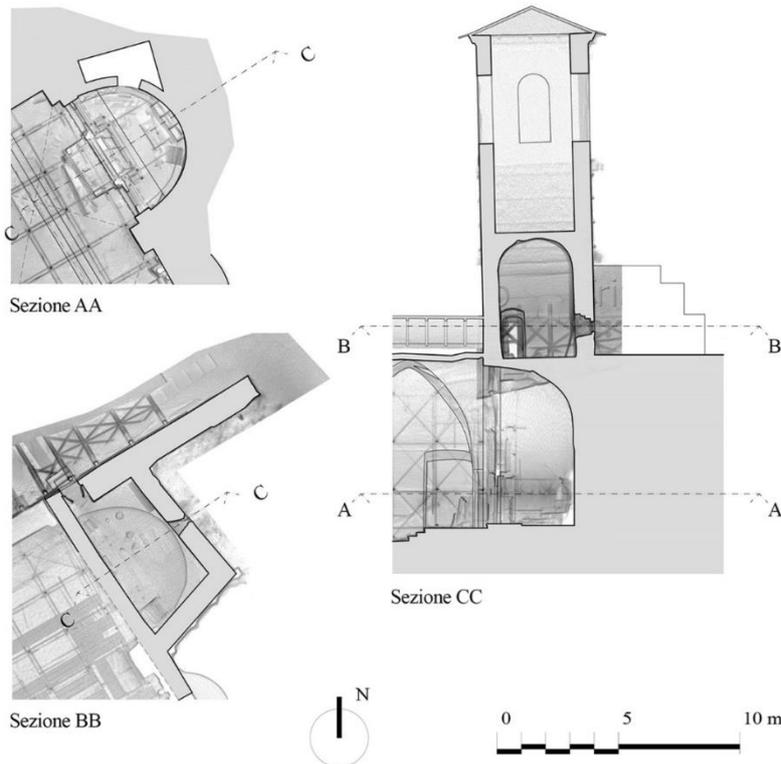
The current work aims to develop this method in a multidisciplinary approach, using the tools provided by geomatics, whose versatility enables the achievement of an optimal solution by integrating the various techniques available.

Among modern digital techniques for rapid mapping, the 3D metric survey allows the realization of a point cloud, with particular attention to the potential of a mobile mapping system (MMS) and the photogrammetry by unmanned aerial vehicle (UAV). Multisensory surveys allow the construction of integrated 3D models, derived from point clouds, which are lifelike and an accurate digital representation of the artefact. Through these models it is possible to understand the architectural system and the assessment of the seismic vulnerability concerning the item of interest. Point clouds, mesh surfaces and volumetric models allow: the definition of the elements that characterize the architecture, the investigations aimed at the static analyses, the inspection of damages, the analysis of deformations and their monitoring over time. This approach of a rapid assessment enables the establishment of a solid database in order to structure the planning of future projects.

This thesis documents the vulnerability of a two-aisle church, Sant'Andrea in Campi, Norcia (PG), which partially collapsed as a result of the seismic events that hit central Italy during 2016.



1. Mash surfaces allow the analysis of deformations and their monitoring over time.



2. Through these models it is possible to understand the architectural system and the assessment of the seismic vulnerability concerning the item of interest.