



POLITECNICO
DI TORINO

Honors thesis

DEGREE IN SUSTAINABILITY DESIGN

Abstract

**UAV and LIDAR innovative technologies for
stratigraphic analysis of masonries:
the cloister of Novalesa Abbey**

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For the purpose of this thesis, we used the latest UAV and LIDAR survey technologies to collect data in order to conduct a stratigraphic analysis of the masonries within the framework of the archaeology of architecture.

Therefore this work concentrates on a methodology that uses the results of a survey in an innovative way, results that have been acquired with geomatic technologies to conduct a stratigraphic analysis of an asset belonging to our historical architectural heritage.

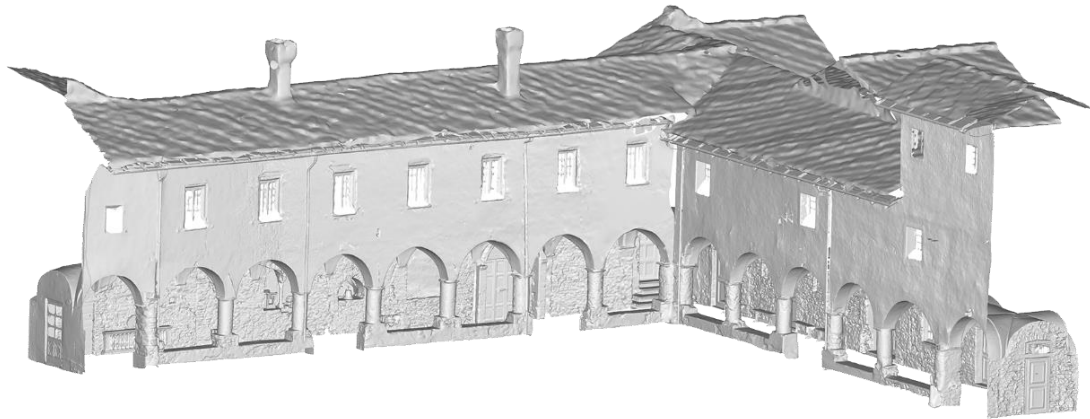
We initially researched the subject of the study, the Novalesa Abbey; then, as part of the initiative undertaken by the DIRECT team (Disaster Recovery Team) and funded by the Turin Polytechnic University, we acquired aerial frames and subsequently laser scans with the aid of drones; at a later time we processed the collected data (in fact, the highly automated survey systems we used need a careful monitoring by the operator). Finally, we conducted a stratigraphic analysis on a section of the abbey's cloister from the obtained results.

The complex of Novalesa has a long and eventful history that deeply influenced its architectural evolution. We chose the abbey as our subject matter of the research because of its rich history, since the surfaces of the masonries have been modified over the centuries and some of these modifications can still be seen.

Over the last decades the abbey has been a subject of research and it has undergone excavation and renovation works. In 2015 a measurement campaign has been conducted, during which the UAV and LIDAR photogrammetric surveys have been conducted.



*Photogrammetric model
of Novalesa Abbey*

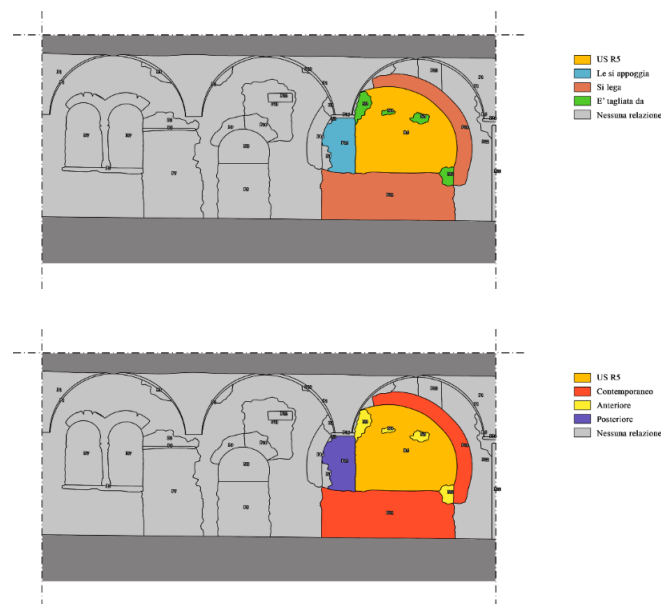


Polygonal model of the northern and eastern arcades of the abbey

At the base of this analysis are the data acquired with these innovative technologies, processed to provide appropriate support to study the stratigraphies (orthoimages, 3D models, DSM and 3D printings have been used afterwards to obtain traditional works such as maps, prospectuses and sections); the main objective has therefore been the identification of the stratigraphic units which compose an architectural object, i.e. the homogeneous elements regarding the materials and the construction techniques.

We focused on a section of the cloister under the northern arcade, which has many interesting characteristics - especially a fresco dating back presumably to the 12th century that has been partially covered by a substructure - and some openings which have been blocked and partially obstructed by the vaults.

We used GIS technology to manage the analysed data, as it was particularly suited for this kind of operation, since it allows to manage, other than the US geometries, their attributes, the topological relations and other relations concerning the objects of the database.



Example of thematization in a GIS environment

Therefore, several UAV and LIDAR technologies have been tested in this thesis and the results are suitable to be applied to the stratigraphic method.

Indeed these surveys provide information not only on the tridimensionality and the geometry of the subject matter of the research, but also on its texture and chromaticity, which are key elements to identify the US and to perform a stratigraphic analysis.

Finally, the findings of these analyses can be inserted into a GIS database and can be easily managed, including successive interrogations and further thematizations concerning every aspect of the database.

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