RECORDING AND PUBLISHING TO ENSURE INFORMED CHOICES FOR FUTURE GENERATIONS

Simonetta Acacia, Marta Casanova
Research Fellow, DSA Department, University of Genoa, Genoa, Italy

Introduction

Conservation of architectural heritage requires a critical understanding of the significance, conditions and complexity of an existing building.

Getting used to the building under different aspects is an essential element of the conservation planning process and provides a long-term foundation for the monitoring, maintenance and management of a site.

The management of a great number of data and information acquired during the knowledge phase, moreover when they are related to a large building, needs a continuous awareness of the position of the single data within the entire complex and of the spatial, temporal and functional connections among every architectural element.

The paper illustrates an application of GIS (Geographic Information System) for conservation of a historical building, which takes advantage of the particularity of this system of overlaying and combining graphical, textual and numerical information together.

The achievement of this experimentation will be the publishing of the project as a web-gis which allows all the interested parts to easily access and consult the documentation recorded and use these information to make well-informed decisions about the conservation of built heritage and produce or improve its knowledge.

The Albergo dei Poveri in Genoa

The Albergo dei Poveri is a monumental complex in the city of Genoa, protected according to the Italian Code of Cultural Heritage and Landscape.

Its construction started in 1656 as a charitable hostel, founded by Emanuele Brignole, a member of Genoese nobility who devoted his life to this project.

The original design, a square plan with two crossed central wings, wasn’t completed when the construction stopped at the beginning of the XIX century: western courtyards are smaller than eastern ones because excavating the nearby hill was too expensive, so the western wing is just a long corridor. However the building we can see nowadays has a total covered surface of more than 60.000 m², organized in eight floors.
The religious and spiritual element ruled both the internal management of the charitable hostel and the organisation of its plan, with the main altar of the Church as the visual and symbolic centre of the entire complex.

In the XIX century it was used as a hospice until 1991, when it was involved in a great intervention of conversion for university uses. Nowadays only 30% of the available surface has been restored and used for university activities, the remaining parts are still abandoned and exposed to decay: the Albergo dei Poveri has lost its functional and spatial unity.

**The research framework**

In 2009 the Athenaeum assigned to the School of Specialization in Architectural Heritage and Landscape of the University of Genoa the restoration/renovation feasibility plan, in order to allow a complete re-use of the complex as a university campus (scientific responsible: Prof. Stefano F. Musso and Prof. Giovanna Franco).

The Albergo dei Poveri has been studied and surveyed for four years by the students and the teachers of the School of Specialization and the students of the fifth year of the Master of Architecture. They analysed different parts of the complex, by architectural survey, archival researches, analysis of its conservation status (materials and decay phenomena) and developed some design hypothesis for the future of the monumental complex.
Today the Albergo dei Poveri is also a case-study of the Research Program of National Interest, “Built Heritage Information Modelling/Management” (PRIN 2010-11 – BHIMM, National Coordinator: Prof. Stefano Della Torre).

The MARSC Laboratory of the DSA Department (Analytical Methods for Restoration and History of Built Heritage) executed a rigorous topographic survey of the perimeter of the building and the digital photogrammetric straightening of all its external surfaces (façades).

All the researches at the University of Genoa were coordinated by Prof. Stefano F. Musso and Prof. Giovanna Franco.

An Information System for architectural heritage

The great number of data and information acquired and produced were initially organized in a relational database (File-MakerPRO-8.2) to ensure their storage and continuous updating.

In order to improve the understanding of data in their reciprocal and spatial relations we chose to carry out a GIS of the Albergo dei Poveri, making use of the free and open-source software QGIS, nowadays in the 2.8.1 version, with its useful plug-ins.

Starting data set

The data we have to process are heterogeneous and differ one from the other in types, media and sources (Fig. 2); some deal with current state analysis like:

- topographic survey;
- digital photogrammetric straightening;
- photographic campaign;
- building features;
- maps of materials and decay phenomena;
- sample analysis;
- actual uses;

others with archival researches like:

- historical photographs;
- historical iconography;
- archival documents;
- bibliographical research;
- past place-names and uses.

We have different digital formats too: the previous relational database, carried out with File-Maker, gathered information about the organisation of the building and current photographs; we could export these data as tables in .dbf format.

Topographic survey was processed with Autodesk AutoCAD2014 and saved as .dxf files; textual, iconographic and photographic archival documentation was digitized as .jpg or .pdf format; some data were already organized in tables.
Project structure and organisation

In order to manage all these data we created a database, paying attention to respect the simple ground rules the relational model bases itself on. The database oversees the relations among tables, each corresponding to one type of data, minimizing data redundancy.

To design each table attributes are assigned, the first step is to identify the basic attributes of the datum to be stored in the columns of the table; each row must be unique in some way.

In order to transfer these rules in our project, we had to identify elementary components for the Albergo dei Poveri.

As regards the spatial organization of the building we re-used the logical structure defined by the File-Maker database, which describes the whole architecture as wings, under-sectors, levels, fronts and rooms.

Qualitative and documentary data were defined and processed in our database as the following themes:

- past place-names of rooms and wings;
- architectural elements (wall, pillar, column, floor, arch, vault, door, window, staircase, etc.);
- photographs (both current and historical);
- maintenance interventions (with different levels of detail);
- building materials;
- state of conservation of the elements;
- decay phenomena of the materials.

As we mentioned before, every theme has its own table; in an information system such as a GIS, you may link a geometry (spatial datum) to a table of contents.

This is the so-called shapefile format, which can spatially describe vector features (points, lines and polygons); the format consists of a collection of files with a common filename prefix, stored in the same directory. The three mandatory

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1 This list is open and could include every other types of data that future studies find out.
files have extensions .shp (shape format, the feature geometry), .shx (shape index format, the positional index of the feature geometry) and .dbf (attribute format, the dBase table that stores the attribute information of features).

Our GIS is organized in different projects (plans, façades, sections and detailed studies related to specific parts) in order to allow a simple and immediate visualisation of the data: these projects use the output of topographic survey, enriched by digital photogrammetric straightening, instead of geographical maps, with customized reference systems.

Each project is distinct in terms of geometry, therefore the same datum may be associated to different shapefiles in different projects. Hence, we separated the feature geometry from the corresponding attribute information using a unique code to link (JOIN) the two tables².

The constantly increasing number of files and the appropriate management of relations among them require to use a unique DBMS (DataBase Management System), in order to carry out complex queries retrieving usable information (knowledge) based on different type of data.

We chose PostgreSQL 9.3³, ⁴, a spatial database by means of its extension PostGIS.

In short, by means of the QGIS desktop application we edited geometries with their simple attribute tables, especially the unique code, and created thematic maps; then we connected our QGIS projects with a database in PostgreSQL through the plug-ins SPIT and DB Manager (Fig. 3).

In PostgreSQL we set relations among the geometrical items and decoding tables where we stored all the attribute information; and we created views, which are like “the illusion of a table”.

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² The main project regards plans of each floor; by means of specific links you can open the other projects.
³ PostgreSQL is a free and open source software, as QGIS; it “is a DBMS that incorporates the relational model for its databases and supports the SQL standard query language”.
Views are read-only and always up-to-date: “each time you execute [...]” the command, “the data is rebuilt”\(^5\).

Tables manipulated in the DBMS and views were imported in QGIS project as layers and dressed up in their visual appearance (Fig. 3).

**Data access**

The final purpose of this work is to publish our QGIS project file on a web-server making use of the QGIS Server\(^6\), which provides a web map service using the same libraries as the QGIS desktop application: the resulting web maps look like the ones on the desktop.

The symbology of a layer is a fundamental aspect in order to allow the data access in terms of the prompt understanding of the map. “Having proper symbology [...] produce[s] maps and information which people will be able to use”\(^7\) and easily to see what the map deals with \(^8\).

All the files and projects, with the necessary applications, were placed and installed on a server in order to access them online by specific account.

Through the platform web-gis the user will be able to browse and consult the project and question it for information by means of forms we set up; the user will also be able to print the outcome of the queries, both as thematic maps and reports thanks to settled layout.

**Applications**

The following examples illustrate the benefits of using GIS for architectural aims.

- Storage and management of photos

  The management and storage of photos taken during the surveys are always a delicate phase that, if not carefully designed, often prevents you from connecting each image with its precise place in the building. This problem is especially hard in case of such a huge building as the Albergo dei Poveri, which is composed of more than one thousand rooms.

  The photos, classified in historical and up-to-date, have been stored in .dbf file containing information about the date of the shooting, the author, the name of the file, the link to the photo and a code referring to the different shapefiles placed in their QGIS projects. By creating a JOIN and by opening the feature form linked with a room (Fig. 4) you can have a preview of the historical and recent photos related to that room.

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\(^5\) Neil, Stones, p. 228.

\(^6\) Dr Annalisa Barla attended to IT support.


\(^8\) In QGIS you may also customize the form for the attribute data capture phase by the creation of own custom forms, using the application Qt4 Designer provided as part of QGIS setup.exe.
Fig. 4. View of the plans project. By selecting a room relevant information, including historical and current photos, are displayed in a form

Source: authors’ elaboration.

Fig. 5. View of the plans project. By selecting an element (a lathwork vault) relevant information are displayed in a form

Source: authors’ elaboration.
Through a quick search, it is easy to find the information related to an architectural element (Fig. 5) and its photos. This process allows to keep all the data information when the project for the restoration and reuse of the building starts even if performed by architects who did not carry out the preliminary studies on the morphology and state of conservation of the complex.

- **Maintenance interventions**

  An important part of the research carried out during these years concerns the archival documents since the construction. Usually the information derived from documentary sources are not directly related to the representation of the building (in plans, façades or sections), but the structure of the GIS allows to combine a document in the archival documentation database with one or more geometries that can be then related to architectural elements, rooms or areas of the building.

  The Albergo dei Poveri was damaged by incendiary bombs during the Second World War and in the following years there have been many maintenance interventions carried out by the Genio Civile⁹. We collected a lot of documentation of these interventions, including measure booklets. These booklets were transformed into tables and each item was associated with a geometry defining the position of the intervention (Fig. 6).

  By selecting an item, this is displayed on the map and the related information with the historical drawings are available in a form.

- **Maps of materials and decay phenomena**

  Some parts of the building have undergone specific studies whose results have been, beside other things, the maps of materials and decay phenomena. In order not to lose these information specific projects have been carried out in QGIS.

  ![Fig. 6. View of the plans project. By selecting a geometry related to maintenance intervention you are allowed to know specific information coming from measure booklet](source: authors' elaboration)

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⁹ The Genio Civile is a State agency situated in each Province that projects and manages public works.
In the section of the room called ex-infermeria (Fig. 7) we can see the overlap of the maps of materials and decay phenomena directly realized in GIS using a digital photogrammetric straightening of the wall as a basis. The pick point of the samples of mortar has been recorded in a shapefile and linked with the .dbf file containing the data resulting from the analysis.

The photo of the sample can be opened by a predefined action.

Through actions we can open not only images, texts or .pdf files but other QGIS projects too; so we created layers which contain links to projects related to the façades or investigations about specific parts or elements of the building.

**Conclusions**

Publishing the QGIS project on the Albergo dei Poveri will allow all the interested parts to easily access and consult the documentation recorded inside and use these information to make well-informed decisions about the conservation of built heritage.

Moreover, a good documentation ensures knowledge to pass on to future generations; an accessible documentation ensures that the dynamic process of knowledge goes on, providing the basis in order to control the information flow and the management of the conservation process.