Producing Project

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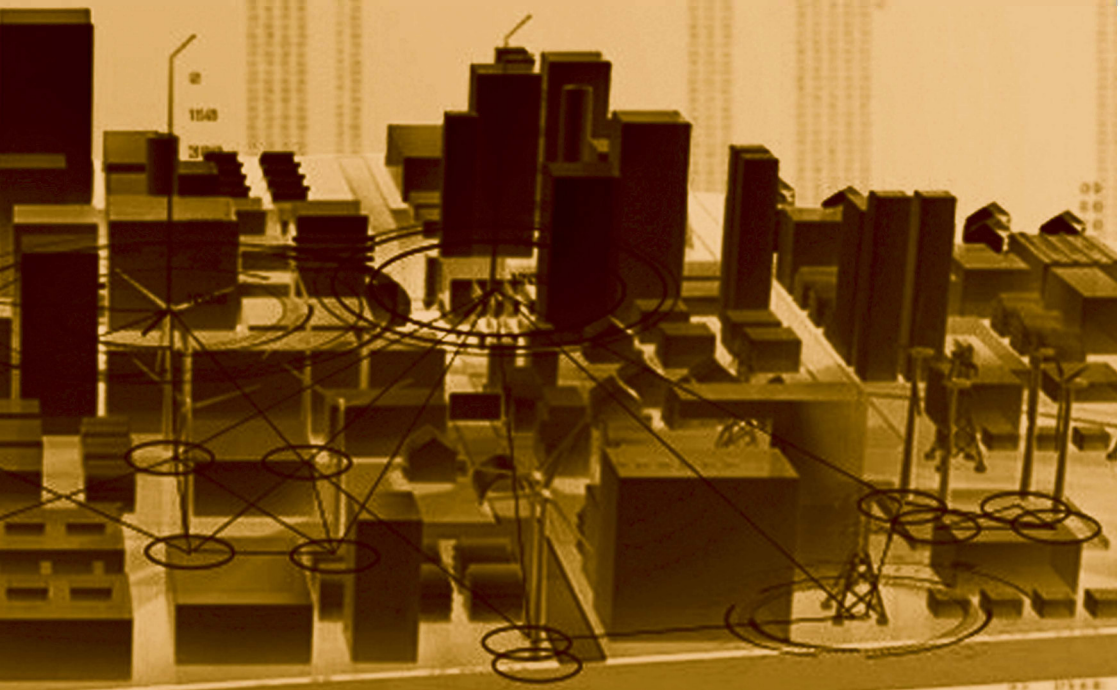

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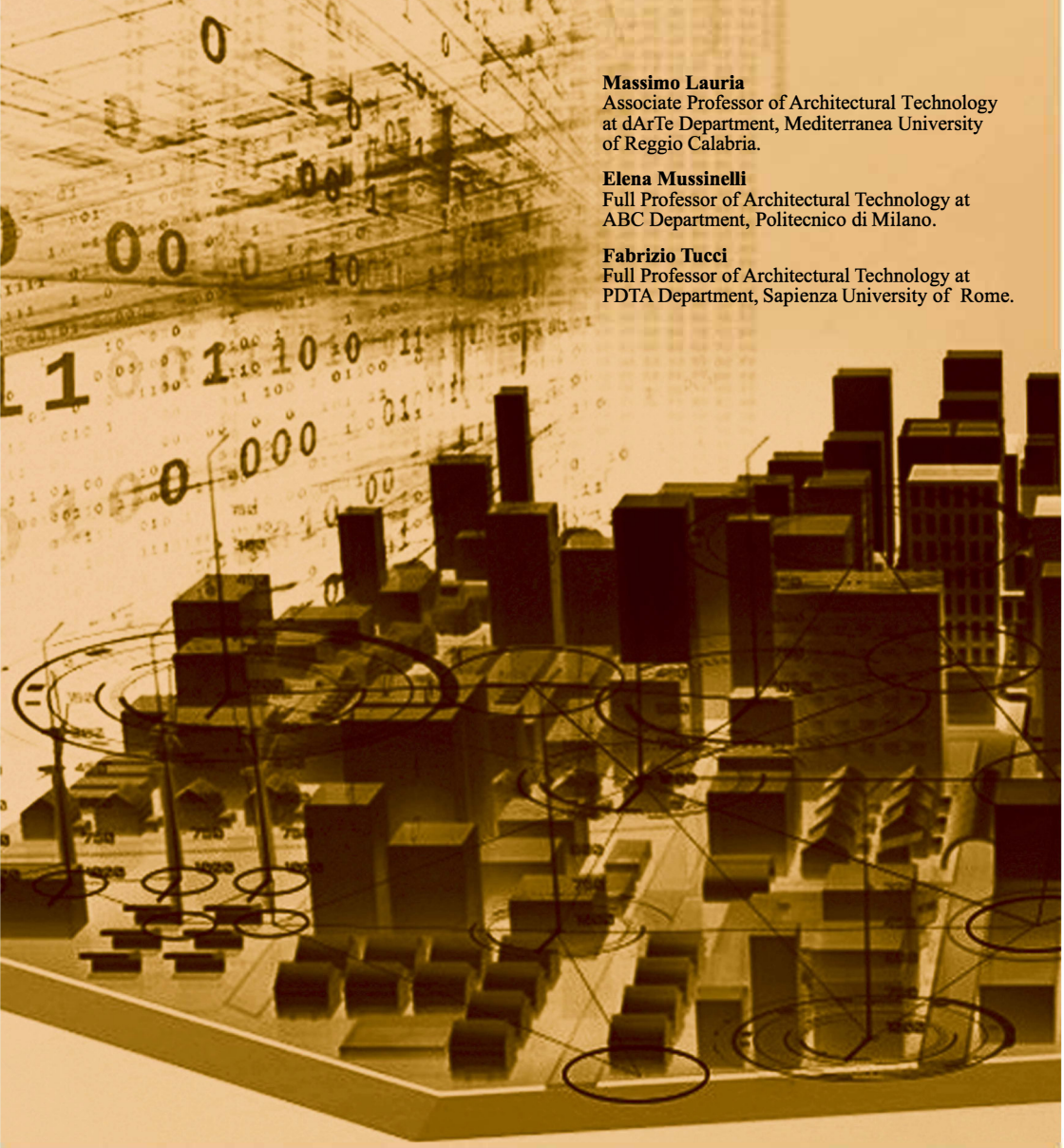

The transformations created about the design activity by the several challenges started by the economic crisis, climate change and environmental emergencies, together with the impact of the Web and ICT on social and productive systems, highlight many critical issues, but also significant prospects for updating concerning places, forms, contents and operating methods of "making architecture", at all levels and scales.
In this context, the cultural tradition and disciplinary identity of Architectural Technology provide visions and effective operating practices characterized by new ways of managing and controlling the process with the definition of roles, skills and contents related to the production chains of the circular economy/green and to real and virtual performance simulations.
The volume collects the results of the remarks and research and experimentation work of members of SIT*d*A - Italian Society of Architectural Technology, outlining scenarios of change useful for orienting the future of research concerning the raising of the quality of the project and of the construction.

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2.12 GIS A TOOL FOR 20TH CENTURY ARCHITECTURE. FROM THE TERRITORY TO THE BUILDING SCALE

Marta Casanova[*]*, Elena Macchioni*[*]*, Camilla Repetti*[*]*, Francesca Segantin*[*]

Abstract

Management, organization, and dissemination of data represent today one of the main topics of heritage protection and enhancement. Through four case studies, this contribution describes the use of GIS (Geographic Information System) applied to 20th century architecture, as a tool for critical analysis of data and their possible use for the design phase. The examination of the case studies highlights opportunities and limits of a peculiar use of GIS in the field of 20th century architecture, taking into consideration its specific features. Investigations developed at territorial, urban and building scale demonstrate GIS strengths and weaknesses for the improvement of projects on existing buildings.

Keywords: GIS, Geographic Information System, 20th century architecture, Database, Georeferencing

GIS applied to 20th century architecture

The knowledge of built heritage as the starting point for a conscious project, be it of maintenance, conservation, or transformation, always requires a critical analysis of heterogeneous data that must be accurately organized and classified. During the 20th century, the quantity of architectures built, and the amount of archival data and documents produced was the largest ever.

The great number of constructions and the enlargement of the heritage definition not only arose new considerations and problems in the conservation field, but also implied an increase in the production of documents related to architectural projects.

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The unprecedented technological evolution of the last century allowed the diffusion of new tools, often developed in other areas and for different purposes, in the field of architectural knowledge and planning.

For example, photography became an instrument for representing architecture: a work tool for planning (photomontages and photographic processing), documenting construction phases (preliminary and site photos), disseminating intervention results, and promoting professional work.

Moreover, together with the consolidation of the concept of authorship, many designers' private archives have been established, retaining not only technical documentation, but also many other kinds of documents (as sketches, correspondence, and press reviews).

In order to benefit of this great availability of material, that represent a resource for the knowledge and planning of projects on existing buildings, it must be adequately managed and therefore interpreted. In this context, the GIS (Geographic Information System) seems to be the most suitable tool for collecting, managing, and processing such quantity of data.

This contribution identifies opportunities and limits of a specific GIS application through the analysis of four case studies, related to 20th century architecture[1]. In doing so, it proposes an assessment of the benefits of this tool not only for the analysis and research phases, but also for the design activities.

The first two investigations, one about cinema-theatres in Emilia-Romagna and the second regarding seaside *colonie*[2] in Liguria, used the GIS to analyse complex data related to a wide territorial context.

The third one, related to the Piccapietra district in Genoa, illustrates how the use of this instrument at the city scale can provide an original perspective on an episode of urban renewal.

Finally, the last case study, about the design, construction, and transformation through time of Giuseppe Terragni's residential buildings, highlights the potential of this tool for the conscious planning of interventions and maintenance of built heritage.

GIS project

Initially developed in the geographic field, today the GIS finds applications in the area of cultural heritage. For example, it is often used to organize data from archaeological excavations or information on building materials and conditions for restoration projects.

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[1] The researches were developed within the PhD program in Preservation of the Architectural Heritage at Politecnico di Milano.

[2] In Italian *colonie* is the plural of *colonia*, a word defining special institutions and constructions for the care of sick or fragile children, built in Italy between the 19th and 20th century. Since an exact translation in English is not available, it is kept in Italian in the text.

This contribution aims to propose an alternative GIS use, in this case as a georeferred graphic expression of a DBMS (Data Base Management System) with a spatial extension. This allows the classification, analysis, management, and visualization of geographical information and archival documents, both images and texts.

This application had been previously experimented by the Architecture and Design Department of the University of Genoa (formerly, Department of Architectural Science) for the management of interventions at the Albergo dei Poveri monumental complex[3] (Musso, 2017; Acacia, Casanova, 2015).

The acquired knowledge formed the basis for the development of the studies described hereafter, where the GIS is not used for the subsequent association of data to a 3D model (Brusaporci, 2017; Campanaro, 2016), but mainly as a work tool since the very first phases of the investigation.

For this reason, the GIS project was built by linking the databases created in DBMS PostgreSQL[4] to the GIS software in order to make the most of the geographical analysis. In this way, it was possible to match the geometries to an informative report, retrieve them according to different topics, and display them in maps and plans. Data, combined and arranged in tables, were then charted using the most suitable geometrical figure (point, line, or polygon) according to the type of object representation (plans on different scales, elevations, sections). Since QGIS allows the management of the spatial representation of data and their related screen consultation[5], in some cases it was necessary to link the data in PostgreSQL to another data-base software (such as LibreOffice Base) to obtain files and reports on the research results.

Thematic maps as a synthesis of complex information

In the investigations on the seaside *colonie* in Liguria[6] and cinema-theatres in Emilia-Romagna[7] the GIS is applied to analyse a large and widespread group of buildings at the regional scale. The seaside colonie in Liguria represent a heritage that is still not enough studied and known within the regional built environment, despite being a characterizing element of some sections of the Riviera due to their number and volume.

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3 Research developed within PRIN 2010-2011, *Built Heritage Information Modelling/Management*.

4 Data gathered for the seaside *colonie* were inserted and organized in a relational database using File Maker Pro software.

5 Data can be displayed on screen, and QGIS graphic elaborations can also be printed.

6 Research title: *From therapy to holiday. Architecture of the seaside colonie for childhood in the Italian riviera. History and preservation of a modern heritage* by Francesca Segantin.

7 Research title: *Success and decline of movie theatres in Emilia-Romagna after the Second World War. Conservation of the architectures for the movies* by Elena Macchioni.

Emilia-Romagna is one of the Italian regions recording the greatest numbers of cinemagoers and venues in the postwar period; hundreds of architectures for the movies still exist on the territory, both in cities and small towns, with many buildings displaying significant architectural and structural features.

Both investigations collected a large amount of data related to the construction history and actual state of the buildings. The main sources of information are bibliographical investigation, archival research (technical documents, drawings, photographs, bill of quantities, etc.), and on site inspections (current use, conservation state, and architectural modifications).

The information collected for each building, diverse by source and type, was arranged in GIS, building an organized system of multiple georeferenced data, that can be displayed on a regional map. In fact, the GIS not only connects all the information to the exact location of the constructions, but also allows to display it according to different themes, based on the categories used to organize the data (for example: current use, architectural features, technologies, materials, etc.).

Moreover, a sheet was set up for each building of the GIS project to clearly present the contents of the database[8]. The sheet includes texts organized in various categories such as general information (name, location, period of construction, and use), architectural features (type, morphology, finishes, etc.), building history (construction and transformations over time, client and designer, etc.), and current state (state, condition, type of use, current ownership, etc.). In addition, historic and recent photographs, together with images of archival documents are inserted in each sheet[9].

The GIS, like the linked database, can be inquired about statistical data through one or more parameters, allowing the visualization of the result at different geographical scales.

Thanks to this kind of complex query, it is possible to create maps that group buildings according to various criteria. The visualization of data inserted in the database at territorial scale, enabled the identification of specific phenomena and peculiar characteristics, providing original interpretations on the subject. As for the seaside colonie, for example, the GIS was crucial to observe the distribution of those buildings on the coast, thus directing the research on deepening the reasons causing this condition.

For the cinemas-theatres, the GIS highlighted the permanence of many active premises managed by public or educational organizations in the historic centres, demonstrating how events related to the property influenced the permanence of the use of these spaces.

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[8] Both databases included active, abandoned, transformed, and demolished buildings, to create a knowledge framework as complete as possible for the period studied.

[9] To display pictures within the building sheet, it was necessary to fill in the URL field for each of them.

Urban space interpretation through plans and projects overlapping

For the case study of Piccapietra district in Genoa[10], the GIS was used in a broader way than in the previously described works. The modern Piccapietra district, one of many that were built in Genoa in the second half of 20th century (Franco, Musso, 2016), was constructed after excavation of the hill underneath it and the demolition of the preexisting medieval district. Even if a modern solution for Piccapietra was in progress since the late 19th century, the district demolition was approved only in 1953, after almost one century of various projects and debates. For this reason, it was necessary to sort and analyse a high number of documents and then georeferring them to single geometries. Thanks to this approach, it was possible to understand not only modern district design and constructive process, but also its layout before and after the war.

Materials inserted into the GIS were mainly cartographic and iconographic documents, such as urban and cadastral plans, architectural projects, aerial photographs, reproductions and general views, old and new photographs. After the first GIS georeferencing phase[11] (with historical cartography, aerial photos, and buildings plans), was then possible to create a virtual reconstruction of the plan of the former district. On this baseline plan, sorting archival images[12], together with damage and reconstruction reports coming from local archives, it was possible to define the war damages extent on every single building. It was thus possible to understand how much had been destroyed, in order to better interpret the following decision to demolish the ancient Piccapietra district.

Furthermore, thanks to the overlapping of these materials in the GIS, it was possible to identify recurring urbanistic and architectural choices, contact points between new and old buildings, and unregistered modifications on existing buildings.

Finally, information about Piccapietra new buildings[13], gathered from literature and archival material consultation (such as administrative documents, projects and images, design reports, photographs, etc.) was inserted in the GIS. In this way, the GIS project became the best tool to reconstruct an updated and layered image of Piccapietra.

This GIS use allowed to piece together and understand a postwar episode of local history, lacking a specific literature, despite the fact it deeply modified the actual Genoa.

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[10] Research in progress, provisional title: *The renewal of Genova after the Second World War between conservation and innovation. The Piccapietra case*, by Camilla Repetti.

[11] The georeferencing work consisted in non-linear transformations linked with reference point on currently existing buildings, on a technical cartographic base provided by Liguria Region.

[12] The archival images related to war damages were inserted in GIS using the position of the recovery point.

[13] For each of the new buildings: date, designer and structural engineer, owner, construction company, materials and techniques, transformations over time.

Georeferencing details for a conscious maintenance project

In the field of the research on Giuseppe Terragni's residential buildings[14] the use of the GIS tool was fundamental to have an immediate overview of their structural history through management and visualization of textual, graphic and iconographic information coming from published literature, archival materials, and surveys. Between 1927 and 1943, Giuseppe Terragni planned and carried out, either alone or in cooperation with other architects, nine buildings intended for multi-family dwellings and two villas[15]. Starting from the study of documentation, the research aims at reconstructing all the architectural modifications carried out from the design, through the building phase, until the subsequent transformations regarding space, distribution, materials, and finishes.

In order to document and integrate all the data related to planning, authorization, building and transformation phases, a database DBMS was created with a spatial extension allowing the visualization through a GIS interface. This database is meant to simplify the interpretation of the documentation related to a single building through the documents of a chronological register coming from different archives. Moreover, the database inquiry simplifies the identification of relationships between different buildings, thus allowing the detection of exchanges, influences, linguistic and typological transfers. Each building is linked to a GIS project. Original drawings constitute the base graphic layout. Then, designs details and documents referred to specific elements in plan or section, are inserted on different layers and linked to the related database sheets. Up to now, photographs of the building phase were inserted in GIS, placing them in the shooting point. The different layers, are organized in different levels, can be laid one on top the other, compared, and interrogated. In this way, the information related to different phases and different buildings are clearly and immediately available. The first analysed buildings demonstrated that reading architectural transformations in plans and creating graphic reports was easier using GIS than a CAD system. Moreover, the georeferred position of the information on maps (documents, details drawings, and pictures) allowed to obtain an overview of the amount of information on the different parts and elements of the buildings. This made possible to identify, for example, architectural elements made after detail drawings by Terragni, more problematic ones, or other that were modified during the building phase, through the analysis of material supply documents and the correspondence between customers and companies. This project was planned in such a way to facilitate future interventions being aware of the history and the knowledge of materials of these architectures.

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[14] Research in progress: *Residential buildings. Construction and transformations in Giuseppe Terragni work,* by Marta Casanova, in collaboration with Associazione Archivio Terragni.

[15] Novocomum, Casa Ghiringhelli, Casa Toninello, Casa Rustici, Casa Lavezzari, Casa Rustici-Comolli, Casa Pedraglio, Villa Amedeo Bianchi, Villa Bianca, Case Popolari via Anzani, Casa Giuliani-Frigerio.

Conclusions and possible developments

The described examples demonstrate how the creation of a database, graphic visualization, and inquiry in GIS environment of the gathered data, constitute a crucial work tool for the understanding of the building history and its actual state. Moreover, through georeferencing, the GIS enable to assemble information heterogeneous by type and chronology, thus optimizing the time of the research, and eventually of the project design. The GIS allows to obtain a knowledge and management system that can be further implemented and modified over time, providing an always updated picture of the current state, therefore useful for the design phase. However, to do so, it is necessary an ongoing and substantial investment in terms of time and resources, that is only possible with the involvement of public institutions or other bodies (Myers, 2016).

The GIS project at territorial scale can be an effective tool for public administration or other subjects to collect the essential information for an informed planning regarding the distribution of resources, or the identification of objects requiring priority interventions. The GIS can expedite this operation by creating a specific query using some of the parameters considered during the survey and investigation phase (such as conservation state, recovery opportunities, significance of the building, etc.). Although the creation of a GIS project requires the operators to have a preliminary knowledge about DBMS databases and GIS software, no special skills are required for consultation. The reading immediacy though the user interface simplifies the transfer of knowledge in case analysis and design phases are assigned to different bodies or implemented in subsequent stages. Finally, the construction of WebGIS platforms starting from the built data-base, allows the online sharing of the collected information (or of part of it) and their quick visualization. Dissemination is a crucial phase, particularly for projects on architectures of the most recent past that generally lack of recognition from the society and too often suffer from interventions not taking into proper consideration their history or material consistency.

References

Acacia, S., Casanova, M. (2015), "Un sistema informativo per l'Albergo dei Poveri di Genova", *Il Progetto Sostenibile*, vol. 36-37.

Brusaporci, S. (2017), *Digital Innovations in Architectural Heritage Conservation: Emerging Research and Opportunities*, IGI Global, Hershey.

Campanaro, D.M., Landeschi, G.N., Dell'Unto, N., Leander Touati, A.M. (2016), "3D GIS for cultural heritage restoration: white box workflow", *Journal of Cultural Heritage,* vol. 18.

Franco, G., Musso, S.F. (2016), *Architetture in Liguria dopo il 1945*, De Ferrari, Genova.

Myers, D. (2016), "Heritage inventories: promoting effectiveness as a vital tool for sustainable heritage management", *Journal of Cultural Heritage Management and Sustainable Development*, vol. 6.

Musso, S.F. (2017), "Architectural restoration, ICT and BIM. The Albergo dei Poveri in Genoa as a case study" in VV.AA., *Built Heritage Information Modelling/management BHIMM*, MREADY - Ingenio, Milano.

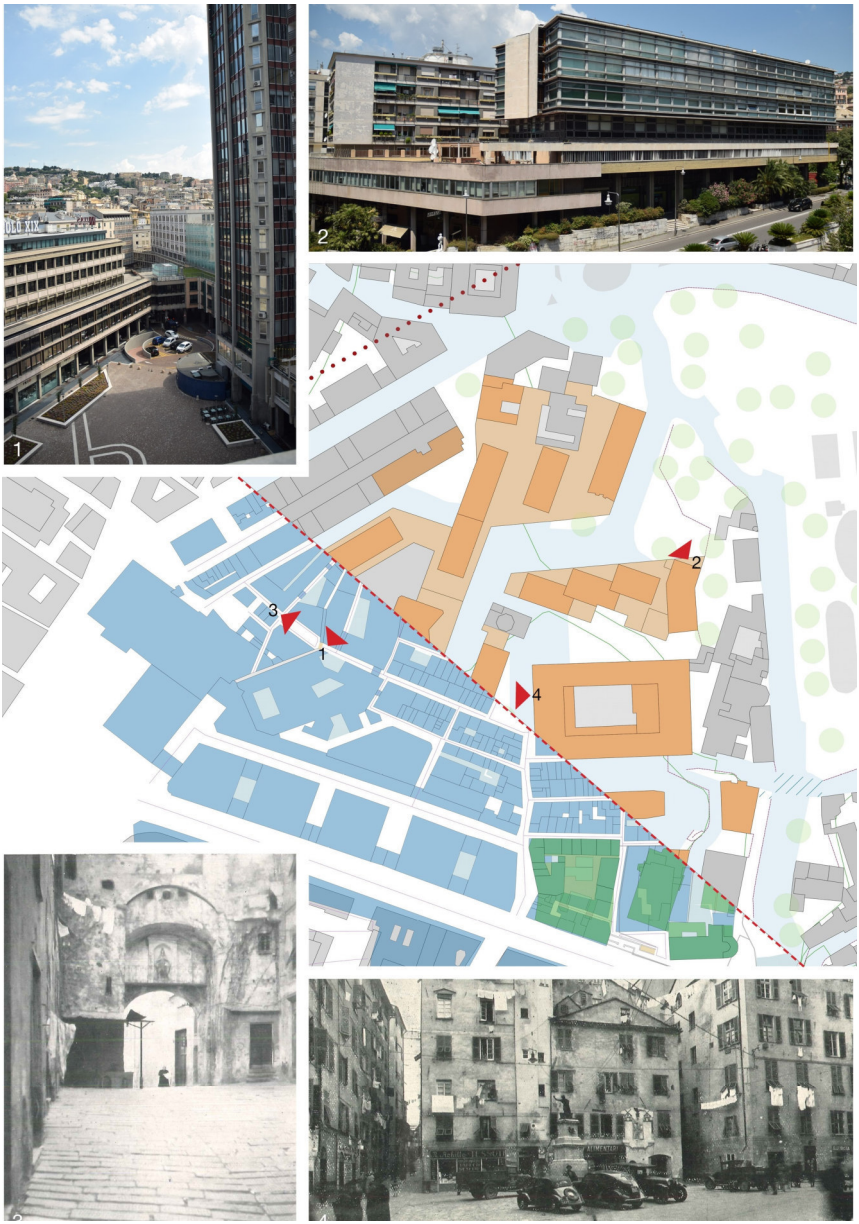

Fig. 1 - Quartiere Piccapietra (Genoa).