Drawing as witness. The Betta-Bardelli Archive between historical memory and digital innovation

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The values of Drawing in the Archives of Architecture between Enhancement and Innovation

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In recent years, architecture and project archives have gained growing significance in cultural and scientific spheres. Universities, originally focused on preserving their own institutional memory, are now increasingly acting as custodians of broader architectural heritage through legacies and donations.
This is the case of the Betta-Bardelli archive, housed in the DISEG Department of the Politecnico di Torino. The archive documents the professional careers of architects Pietro Betta and Felice Bardelli from the post-war period to the 1980s, with a specific focus on the Turin area and northern Italy.
The ongoing research and valorization project explores innovative digital tools for organizing, representing, and communicating the archive's contents. Interactive maps and navigable virtual environments have been developed to allow users to access drawings and simplified 3D reconstructions, enriched with historical and technical data.
The initiative highlights key themes such as social housing (especially INA-Casa projects), public service buildings, and religious architecture, analyzed at different design scales—from urban plans to construction details. One emblematic case study is the INA-Casa office building located at the corner of Via Giolitti and Via Lagrange in Turin.
The project is documented through a wide range of materials, from photographs of wartime damage to structural calculations and detailed construction drawings.
This archive thus becomes both a tool for research and a medium for narrating urban transformation processes through interactive maps and information models linked to documents and drawings of the historical Archive.

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UNIVERSITY ARCHITECTURE ARCHIVES

Drawing on international case studies and an analysis of best practices, this contribution explores the potential of archival and scientific repositories in documenting the study, design and construction of contemporary architectural and engineering works. The research highlights innovative policies and actions for preserving, communicating and disseminating university cultural heritage, particularly that relating to architecture archives. The study explores how this heritage, consisting of drawings, models and books, among other things, has changed its epistemological value, evolving from a teaching tool or a design tool to a 'messenger' of the tangible and intangible values of university culture. Furthermore, the research provides an opportunity to consider how these values can be communicated beyond technical and specialised contexts, bearing in mind that universities have a third mission dedicated mainly to developing connections with civil society through disseminating their research practices (Carrión García et al., 2012; Sabatini, 2022; Gaffaro García, 2025).
In this context, the study presents a project for the digitisation of the Betta-Bardelli architecture archive, which is held at the Department of Structural, Building and Geotechnical Engineering (DISEG) at the Politecnico di Torino. The archive contains materials relating to the professional work of the architects Pietro Betta (1878–1932) and Felice Bardelli (1905–1993), dating from the 1930s to around fifty years later. Particular attention is given to buildings designed in the Piedmont area.
This study critically explores the relationship between real representations and virtual reinterpretations of the archive. The project aims to create a web-GIS platform on which the digitised archival records can be consulted and the philological models representing the buildings in their various design stages and/or urban contexts can be viewed. The goal is to make a paper archive, which is currently held in a university department and is not easily accessible, available to a diverse audience.

ARCHITECTURAL ARCHIVES ARE NOT JUST DRAWINGS

In recent years, the topic of architectural archives has been (and still is) the subject of a lively cultural debate. Naturally, the main focus of the debate revolves around the role of such archives in preserving materials related to architecture, such as drawings, photographs and documents (aaa-italia.org; Carassi, 2023; Palestini, 2016, 2017). However, numerous other aspects are also relevant, including virtual architectural reconstruction (Spallone & Paluan, 2016; Spallone & Bertola, 2020), design process reconstruction (Tomioka, Tabata & Ojika, 2022; Palestini, 2022), and archival material enhancement (Palestini, 2023; Palestini & Lorenzo, 2024). Nevertheless, architectural archives lie at the heart of a broader debate. Meister (2021) considers these archives to be privileged places for studying the production and dissemination of norms, standards, and administrative processes. In this sense, architectural archives can bear witness to the definition and transformation of the technical essence of architects' language (drawing) and the decision-making processes underlying project development. Conversely, Tewes (2019) highlights the significance of architectural archives and their materials in architectural and artistic education. He suggests connecting high school students with 'the tangible aura of original archival sources' to enable new sensory experiences as they handle handwritten and hand-drawn books or sketches, listen to audio material, smell silver gelatin photographs, and touch different paper textures, from illuminated manuscripts to today's floor plans. Thus, the educational value of archival material is supported by its physical qualities, which can drive the dissemination of the knowledge it contains. In the context of education, Quaglio and Casey (2021) emphasise the role of 'primary sources' in architecture and art education that can be found in architectural archives. Teachers, architects, artists, and designers can use archival materials to inform their 'information-seeking habits' and, above all, their teaching methodologies based on these habits. This is essential for professionals who conduct compositional research based on a solid foundation of visual inspiration. Eom (2024) offers a different interpretation of the architectural archive, suggesting that it can emerge from a specific set of materials collected without a clear architectural objective. For instance, it could be formed from a collection of photographs taken for military surveillance purposes of an urban area and its 'architectural' spaces, such as squares and streets.

ARCHITECTURAL ARCHIVES: EXAMPLES

In an international context, a multifaceted approach to architectural archives emerges. There are both architectural archives directly related to architecture/engineering education (Tewes, 2019; Quaglio & Casey, 2021) and archives of famous (or less famous) professionals (Spallone & Paluan, 2016). The Architecture Collection of the MIT Museum is notable among the former, as it contains thousands of thesis projects and class drawings from the late 19th and 20th centuries, showcasing the professional work of MIT alumni and faculty, including Kallmann McKinnell & Wood Architects (mitmuseum.mit.edu). Another notable international institution is the TAM – Architektur Museum of the Technische Universität München (architekturmuseum.de). This institution is a veritable architecture museum with an adjoining archive. It preserves numerous drawings and models made by its students. Another German institution is the DAM – Deutsches Architekturmuseum in Frankfurt am Main. With a museum-like structure, the DAM preserves over 200,000 drawings, 35,000 photographs, and 1,300 models, documenting the professional lives of architects such as Louis I. Kahn, Ludwig Mies van der Rohe, and Rem Koolhaas (dam-online.de). In Italy, the MAXXI Museum's Architecture Archives Centre (maxxi.art/en/centro-archivi/) holds over 60,000 drawings, 75,000 photographs, and other documents and models relating to professionals such as Aldo Rossi, Paolo Soleri, and Superstudio. These examples illustrate what an architecture archive encompasses, as the term not only

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refers to 'drawing archives', but also includes all visual artefacts created in the context of architectural processes (Gay, 2015). Notably, the same university institutions and their architecture and engineering schools often serve as venues for preserving these archives, which are frequently integrated into the university's museum facilities. Clearly, the value of universities' academic heritage, in this case architecture archives, is becoming increasingly diversified. While academies initially served as mere repositories of their own material and immaterial history, they are now also becoming repositories of the history and progress of subjects directly related to them, thanks to bequests and donations. Following these transfers of ownership and/or temporary deposits, these collections evolve from private to genuine archival collections (Bodrato, 2023). This process expands the value of these archives, transforming them from 'simple' repositories of memory into important drivers of scientific research (Palestini, 2022; Farroni, 2023) and true cultural hubs (Simpson, Fukuno & Minani, 2019).

PROTAGONISTS OF THE ARCHIVE: PIETRO BETTA AND FELICE BARDELLI

Pietro Betta and Felice Bardelli were leading figures in Turin's architectural and urban planning scene during the two post-war reconstruction periods. Betta was a professor at the Faculty of Architecture in Turin (Chair of Urban Planning) and at the Faculty of Engineering (Chair of History of Styles). He is renowned for his comprehensive vision of the Taylorist urban model (Magnaghi, Monge, Re, 1995, p. 349). His most notable projects include Casa Avezzano (1912) (Fig. 1a) and the Palazzo "Ordo Restaurationis, Restauratio Ordinis" (1929) (Fig. 1b), both located in Turin.
Felice Bardelli graduated in Civil Engineering (with a specialisation in construction) from Turin in 1927 and began his professional career in Betta's studio. There, he formed close professional ties with the architect Domenico Morelli and collaborated with him on numerous projects (Magnaghi, Monge, Re 1995, p. 149). Bardelli sided with the 'concrete articulation of rationalist method and poetics in relation to local technical and structural conditions', a position also held by Morelli and other architects, including Grassi, Passanti, and Perona (Magnaghi, Monge, & Re, 1995, p. 155). His most notable projects include Casa Tabusso (1934) (Fig. 1c) and the building at 29 Corso Re Umberto (1953) (Fig. 1d), both of which he designed with Morelli and which were built in Turin. His contributions to the design of lot F of the Ina-Casa in Turin's Vallette district are also noteworthy. This project was coordinated by Gino Levi Montalcini and involved Bardelli, Ceresa, Morelli, Passanti and Vaudetti.

ARCHITECTURE AND THE CITY: A PROJECT FOR SHARING AND DISCUSSION

As previously mentioned, the Betta-Bardelli Archive comprises graphic tables, project documents, correspondence, and photographic material relating to works primarily carried out in Piedmont and other Italian regions during the 20^(th) century. Georeferencing archival records is a strategic way to enhance and make this heritage accessible. It allows the works to be placed in their territorial context, facilitating spatial thematic analysis. Adopting an interactive WebGIS platform enables archival data to be integrated into a dynamic system, facilitating the cartographic visualisation of projects, the construction of thematic itineraries, the comparison of interventions, and the analysis of urban and landscape transformations over time. Additionally, the system enables the integration of advanced descriptive and analytical information models relating to various design solutions.
Similar projects have already been developed in academic and institutional settings. Examples include the Archaeological Territorial Information System of Rome (SITAR), which is available on the ArcheoSTAR platform (https://www.archeositarproject.it/piattaforma/webgis/); the Bagolini Archaeology, Archaeometry, Photography (LaBAAF) project, which is affiliated with the Centre for Advanced Studies in the Humanities (CeASUm) at the University of Trento's Department of Literature and Philosophy (https://r1.unitn.it/labaaf/webgis-e-archivi/) and the IUAV Project Archive (ArchiRès GIS, École d'architecture de Paris-Belleville), have demonstrated the effectiveness of geospatial technologies for managing, disseminating and enhancing historical archives and cultural heritage. These systems integrate textual information, images, and digitised documents with specific geographical coordinates, offering an accessible, integrated view of documentary heritage [1].
From this perspective, georeferencing the Betta-Bardelli archive is a vital step in the digitisation process, promoting scientific research, teaching and public participation. The project involves creating an interactive WebGIS platform that allows users to search project files by geographical location or text, according to criteria such as name, date, client, type of work or document, scale of

Fig. 1 - Examples of projects carried out by the protagonists of the research. Pietro Betta: a) Avezzano house (1912); b) Palazzo 'Ordo Restaurationis, Restauratio Ordinis' (1929); Felice Bardelli: c) Tabusso house (1934); d) Corso Re Umberto 29 (1953).

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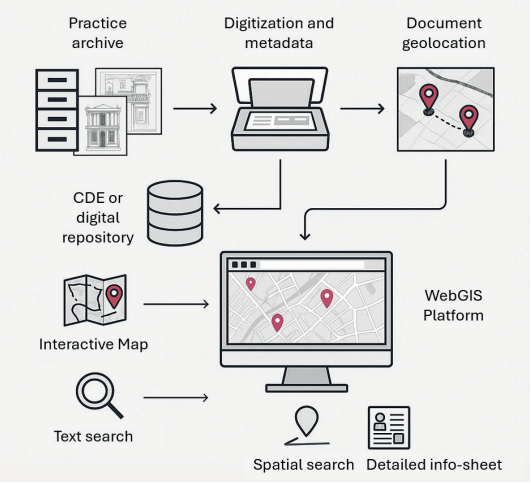

Fig. 2 - Architecture and the City: A Project for Sharing and Discussion.

representation, and graphic content. Users will also be able to consult complementary digital documentation, such as images, information models and descriptive sheets. Each project, understood as a documentary unit stored in folders, will be associated with a structured set of metadata and a precise spatial location. This will allow the consultation and direct comparison of building interventions carried out by the Betta Bardelli studio.
The project will be divided into several operational phases (Fig. 2). Firstly, the drawings and documents will be digitised at high resolution and accompanied by standardised descriptive sheets containing information such as the file's title, location, date, architectural description, number and scale of drawings and author. At the same time, each file will be georeferenced using surveys, digitised historical maps, or open-source mapping services, such as OpenStreetMap or Google MyMaps.
This processed data will be organised in an interoperable database that complies with international standards (e.g. CIDOC-CRM [2]) and will be integrated into a WebGIS platform that is developed using open-source technologies (e.g. Leaflet or OpenLayers [3]) and spatial databases (e.g. PostGIS). The user interface will enable map navigation, access to documents and images, and the downloading of PDF files, as well as further exploration of historical and design contexts.
Advanced features are also planned, including a timeline for chronological project consultation, the ability to create thematic itineraries (e.g. post-war school architecture), and, in the future, the integration of three-dimensional historical information models and augmented reality applications. The project will involve an interdisciplinary network of collaborating entities: As the conservatory and scientific reference body, DISEG will work to ensure a coordinated and scientifically sound approach. The platform is intended for a broad and diverse audience, including students, researchers, professionals, local history enthusiasts, and citizens. It will offer an open and transparent tool for gaining knowledge about the territory and 20^(th)-century architectural heritage.
The proposed system is also versatile and cross-cutting, supporting research activities, interdisciplinary educational courses, and active citizenship practices. The ability to query the archival heritage using geographical, chronological and thematic criteria provides new perspectives for study and dissemination, engaging with contemporary issues such as urban regeneration and historical memory.
Finally, one of the most significant aspects is the model's potential for replication. The methodological approach adopted, which is based on data interoperability, open-source technologies and international standards, makes this experience transferable to other architecture archives in universities and institutions [4]. This contributes to the construction of a digital network for enhancing cultural heritage. The science of drawing facilitates the spatial and conceptual visualisation of architectural archives, thereby enabling consultation through interactive geographical maps that integrate historical, topographical and design data in an intuitive and accessible manner.

THE DIGITISATION OF THE BETTA-BARDELLI ARCHIVE

The enhancement and dissemination project focuses on investigating and experimenting with new methods for processing, organising and communicating the information contained in the archive. The primary objective is to use information technology to maximise the expressive and communicative potential of the documents. This enhancement process involves accessing and integrating heritage with new knowledge (Novello & Bocconcino, 2006; Bocconcino & Vozzola, 2022), but most importantly achieving results that improve accessibility for scholars and a wider, more diverse audience (archive-venice.org). The ISEG Department has undertaken various knowledge-sharing initiatives with the aim of sharing documentation from the archives kept at its headquarters. The most significant of these is the creation of interactive maps to contextualise the projects and documents describing them. This is achieved by creating philological models that summarise the design dynamics that characterised the architecture proposed by the two professionals. Digitising the archive primarily aims to create navigable virtual environments that allow users to access and consult the archive's drawings and three-dimensional reconstructions of buildings via simplified geometric models that nevertheless contain a large amount of information. The first phase of the research project involved surveying the collection to provide a georeferenced account of the interventions promoted by the two professionals at a national level, focusing particularly on the numerous projects developed for and in the Municipality of Turin. This analysis enabled us to assess the consistency of the designs in relation to the current state of the sites and contextualise the transformations undergone by individual buildings in relation to the social changes resulting from the urban evolution of the city's neighbourhoods. This initial phase was preparatory and foundational, exploring the consistency of the drawings in our possession and enabling us to identify topics worthy of further study.

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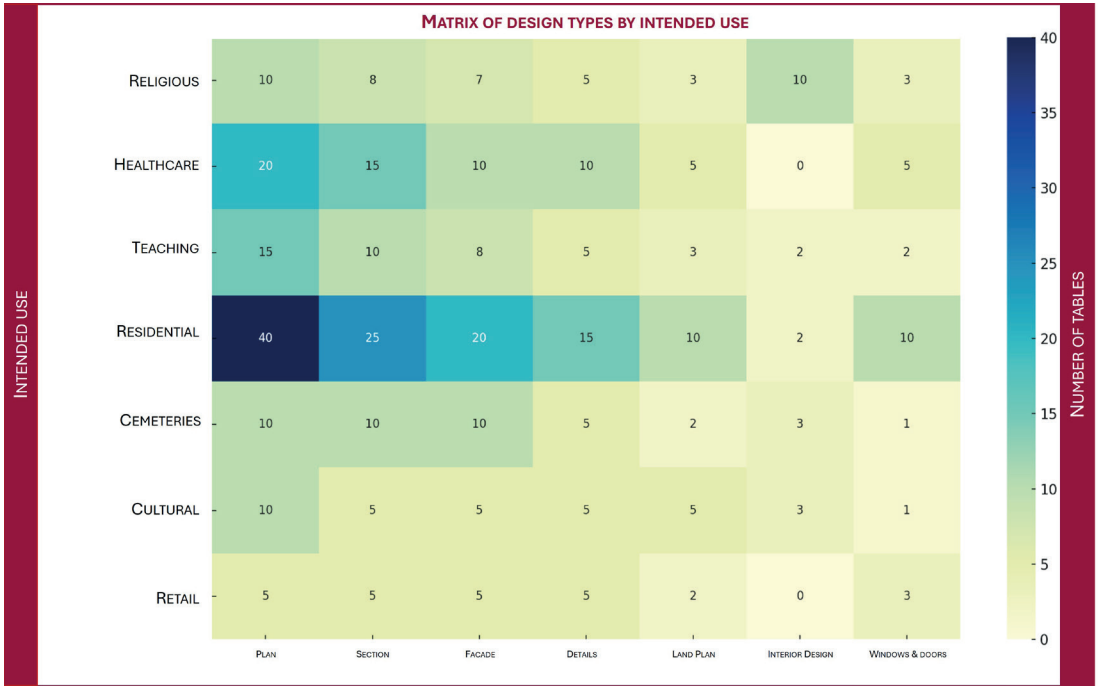

Tab. 1 - Relational matrix correlating the intended uses of the projects in the Betta Bardelli Archive, the types of representation, and the number of associated plates.

The archive documentation (Table 1) was initially organised into four macro-categories, corresponding to the four types of filter that can be used to search for material on the online platform:
1. Location: Bardonecchia, Cherasco, Courmayeur, Giaveno, Rome and Turin.
2. Intended use: commercial, cultural (with a focus on theatres), educational, funerary, industrial, orphanages, religious, residential (with a focus on building cooperatives and workers' housing), healthcare.
3. Representation: floor plans (urban, block and lot scale); plans (architectural scale, basement, ground floor, first floor, etc.); sections; elevations (street front and courtyard interior); construction details (shutters, railings, stairs, furnishings, etc.); axonometric projections; perspectives and sketches; technical documentation (surface calculations, topographical calculations, indexes, etc.).
4. Scale of representation: suitable scales of representation have been identified for the various types of representation: urban scale: 1:5000, 1:1500, 1:1000 and 1:500; floor plans and architectural scale: 1:100, 1:200, 1:50; construction details and furnishings: 1:1, 1:5, 1:10, 1:20.
These four categories encompass all the representation techniques and scales employed in building design. This is essential for representing and historically reconstructing volumes, and for understanding their spatial evolution within their urban context.

FELICE BARDELLI AND THE INA PROJECT AT THE CORNER OF VIA GIOVANNI GIOLITTI AND VIA LAGRANGE IN TURIN

An initial exploration of the archive highlights themes of particular interest, such as social housing, public service buildings, and religious buildings. We will focus on the project for the construction of a multifunctional building designed by Felice Bardelli for the Istituto Nazionale delle Assicurazioni (National Insurance Institute) in Turin's city centre between the late 1950s and mid-1960s. The aim was to redevelop a block that had been severely damaged during the Second World War.
This project served as a testing ground for the digitisation of the Betta Bardelli Archive, as the relevant files contain almost all the documents relating to it. These include the preliminary design by architect A. Beveresco, which was later replaced by Bardelli; numerous executive and detailed design drawings containing graphic designs at various scales of representation, from the urban level (1:500) to the construction level (1:20, 1:10, 1:1); and the dimensional calculations of the reinforced concrete structures (see Figs. 3 and 4).
The INA was established by Law No. 305 of 4 April 1912, issued by the fourth government of Giovanni Giolitti. The aim was to nationalise the life insurance market. The Institute's activities formally began with the first meeting of the Board of Directors on 12 September of the same year (Potito, 2012). Throughout its history, the Institute has expanded into various branches of the insurance sector. However, it gained considerable prominence when it became one of the main players in the reconstruction of Italy after the Second World War, particularly through the Plan for the Increase of Worker Employment and Housing (INA-Casa), also known as the Fanfani Law. This programme ran from 1949 to 1963 and led to the construction of over 350,000 social housing units (Scelsi, 2022), establishing the INA as a driving force behind Italy's social and building reconstruction. The INA-Casa plan's construction projects involved many leading professionals on the Italian scene, including Adalberto Libera, head of the INA-Casa

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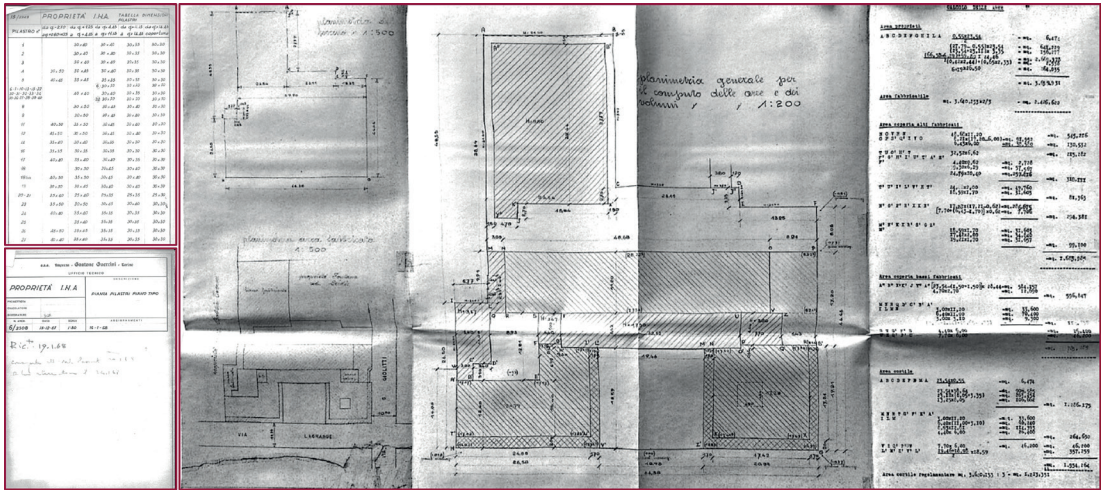


Fig. 3 - Shows INA House at the corner of Via Giovanni Giolitti and Via Luigi Lagrange in Turin (1956), designed by Felice Bardelli. The image is a general plan on a scale of 1:200 with attached urban planning calculations and is a heliographic copy. Betta Bardelli Archive, INA File 2, unnumbered.

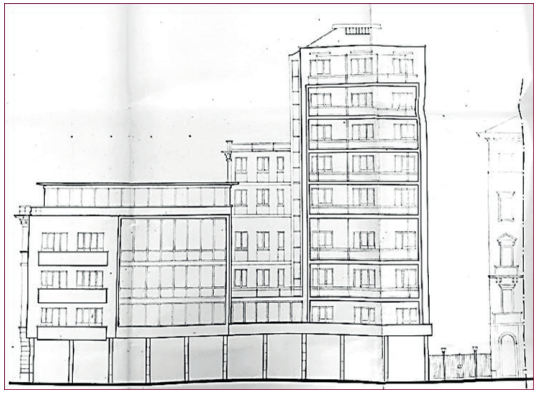
Design Office in Rome until 1951 (Escuero 2020; Pisu 2020). Projects carried out under the INA-Casa programme have been the subject of intense national and international scientific debate (Di Biagi, 2010; Pilat Zeier, 2014). However, there are also projects that were not included in this programme but were promoted by the same institute. One such project is analysed in this paper and can be attributed to a building programme aimed at healing the urban scars left by the Second World War. The proposed case study is part of a collection examining the architectural identity of Turin in the post-war period, when large parts of the city were rebuilt following bomb damage (Fig. 5). It is in this context that the INA building, which is used for residential, commercial and tertiary purposes, is located on the corner of Via Giovanni Giolitti and Via Luigi Lagrange. The archive documentation relating to this project provides evidence of the transformations of the urban area in the form of a rich and varied collection of documents. The different types of preserved materials provide representations closely linked to the building's various design phases (de Rubertis, 1994). The archive files include records of war damage, documented by photographs and thematic tables of demolitions, as well as structural design documents, including calculations and working drawings of the reinforcement. There are also architectural construction details, such as the window sill details overlooking Via Giolitti and Via Lagrange.

PHILOLOGICAL INFORMATION MODELS

The reconstruction of buildings based on archival documentation is currently the focus of renewed interdisciplinary interest involving architecture, engineering, history, digital humanities and technology. In this context, the extensive and detailed graphic documentation collected in the archive files compiled by the designers has made it possible to reconstruct the various design proposals for the building by integrating different digital tools and multidisciplinary methodologies and approaches geared towards conserving, understanding and enhancing the built heritage.

The building model was created using a Heritage Building Information Modelling (H-BIM) approach to achieve a philological restoration, integrating heterogeneous sources such as design drawings, archive texts and photographs into a single parametric model. This approach has enabled us to model the building's historical phases, understand its design and evolution, and identify its distinctive architectural features. It has also allowed

Fig. 4 - Shows the INA-Casa building at the corner of Via Giovanni Giolitti and Via Luigi Lagrange in Turin in 1957. The elevation on Via Giovanni Giolitti is by Felice Bardelli and is from the Betta Bardelli Archive, INA File 1, Document 60. The building's appearance has changed over the years.



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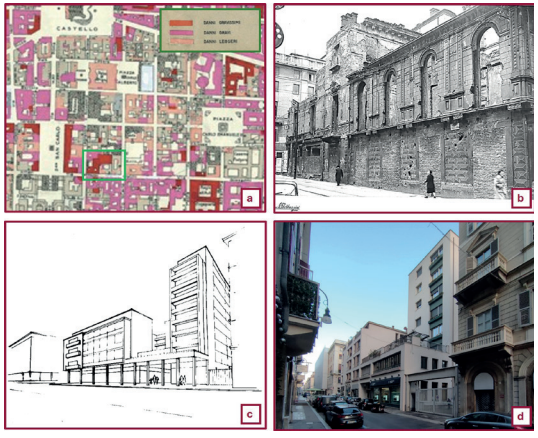


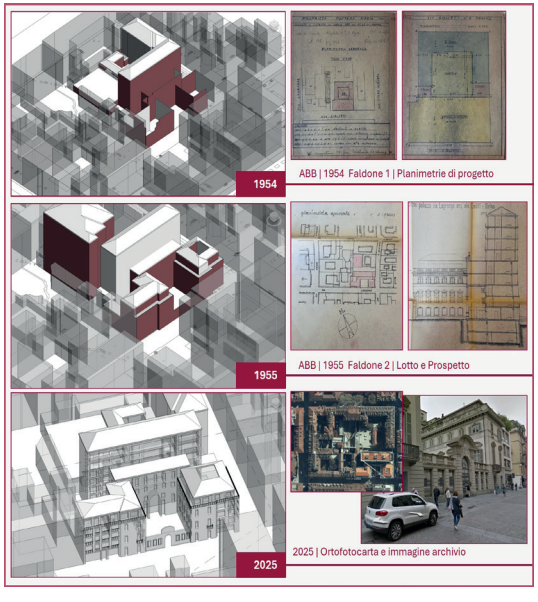
Fig. 5 - Case study from the Betta Bardelli Archive:
a) Damage to buildings caused by Allied bombing in Turin (1946), City Fire Brigade Headquarters, Historical Archive of the City of Turin, Types and Drawings 68.1.2. The colours indicate the severity of the damage: orange indicates minor damage, magenta indicates serious damage, and red indicates very serious damage; b) An image showing the state of the site after the Second World War (Betta Bardelli Archive, file INA 1, unnumbered document); c) INA Casa, Via Giovanni Giolitti corner Via Lagrange, Turin, 1956. Felice Bardelli. Perspective view of Via Giolitti. Ink drawing on paper. Betta Bardelli Archive. INA file 1. Unnumbered document; d) Image depicting the current state of the site (MV, 2024).

us to trace changes over time, track subsequent design iterations, and document war damage, restorations, and design adjustments requested by clients in response to evolving functional requirements (Fig. 6). The models of the various design solutions will be included in the georeferenced digital archive, providing an accurate spatial representation of the building in its urban context. In turn, the H-BIM model will be linked to a relational database to associate virtual elements with their respective documentary sources. For example, modelling a window frame will link it to the historical table showing its detailed two-dimensional representation drawn up by the designers.

CONCLUSIONS

In a context where historical knowledge, urban regeneration and civic participation are increasingly dependent on digital tools, this initiative represents a convergence of memory, innovation and territory. The project's anticipated outcomes are multifaceted, with substantial implications for the scientific, cultural, and social realms. Firstly, the project aims to ensure public access to the Betta Bardelli archive through a free, map-based digital platform. This platform enables users to view the digitised archive documentation and the philological models of buildings in different historical and urban contexts. Open and transparent access to the platform provides a tangible opportunity to enrich an archival and documentary collection, making it accessible not only to the academic community, but also to citizens, students and professionals. These users will be able to access guided consultations and search the document database by topic. At the same time, the project aims to promote knowledge of 20^(th)-century architecture in Turin by restoring visibility to, and accessibility of, the material contributions of two leading figures in their time's architectural landscape. Mapping, georeferenced analysis and three-dimensional philological reconstruction of the works offer new insights into urban and territorial transformations over the last century.
From an epistemological perspective, the presented research also enables us to closely observe changes in the constitutive paradigm and the use of representations contained in the Betta Bardelli archive. The visual artefacts that make up the archive were created to make the hermeneutic process underlying the authors' design thinking visible — and consequently tangible. However, once the libido edificandi or compositional moment has ended, this representative paradigm is transformed into an eidetic support for the processes of knowledge of the architectures described by the graphic works themselves, becoming visual memories and drawn testimonies.

Fig. 6 - Shows examples of visualisation of philological information models that integrate heterogeneous sources for the enhancement of built heritage: the INA building at three different moments: 1954, 1955 and 2025.



Author Contributions Statement
Although the contribution was conceived jointly, M. M. Bocconcino is author of paragraph Architecture and the city: a project for sharing and discussion; M. Pavignano is author of paragraphs Architectural archives are not just drawings; Architectural archives: examples; Protagonists of the archive: Pietro Betta and Felice Bardelli;, M. Vozzola is author of paragraphs The digitisation of the Betta-Bardelli archive; Felice Bardelli and the INA project at the corner of via Giovanni Giolitti and via Lagrange in Turin; Philological information models. University architecture archives and Conclusions was coauthored by all authors.

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NOTE

[1] These WebGIS systems were developed entirely with Open-Source technologies such as Mapserver/MapBuilder as the WebGIS engine and development suite, and PostgreSQL/PostGIS as the relational database management system for spatial data management. The entire project was developed in accordance with the standards of the Open Geospatial Consortium (OGC) to ensure full multi-platform interoperability and simplify collaboration between the various partner institutions.

[2] Conceptual Reference Model is an international standard developed by the International Committee for Documentation (CIDOC) of the International Council of Museums (ICOM). It is recognised as ISO standard 21127:2014 and is one of the main tools for the semantic modelling of cultural knowledge.

[3] Leaflet and OpenLayers are two of the leading open source JavaScript libraries for creating interactive maps on the web. Both allow you to view geospatial data, overlay information layers (e.g. markers, polygons, rasters), and interact with the map content. They are essential tools for developing modern WebGIS that can be accessed directly from a browser, without the need for desktop GIS software.

[4] For instance, a primary concern pertains to the online accessibility of HBIM models. Presently, these models can be disseminated on various online platforms through the utilization of complimentary viewers, including usBIM, Dalux, BIM Voyager, and BIMData.io.

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