METHODS AND PRINCIPLES FOR THE READING, ANALYSIS AND VIRTUAL RECONSTRUCTION OF URBAN FABRICS THAT HAVE DISAPPEARED

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Abstract

The research proposed in this short article, try to show one of the possible methods to analyze and study some urban fabric, in historic cities in the first place, that have been lost or have been heavily modified over the centuries, dramatically changing their appearance. In particular, the study is aimed at cataloging of archival records for the area of the Imperial Fora in Rome, especially, in this first phase, in the areas adjacent to the archaeological ruins. Therefore, the case study is undoubtedly one of the most complex in terms of urban stratification. The lost Alessandrino district, demolished to make way for the Via dell'Impeo has been carefully analyzed, the documents were redrawn in digital, and we are seeing to the three-dimensional reconstruction to the computer.

1. Introduction

In our cities, we often find neighbourhoods that have been ripped apart, losing their historical structure. But what would that part of the city look like if it hadn't suffered a bombing raid, if it had not been shaken by a strong earthquake, if it had not been deliberately demolished?

Urban voids have their intrinsic social properties. They have become a symbol of environmental and historical vicissitudes, a historical memory that characterizes them. In many cases, we can understand the morphology of the place ante rem through the help of the entire historical and archival documentation. However this documentation is accessible to only a few people and more importantly, it is often not organized.

Another interesting source, for the more recent cases, is photographic documentation, which over the decades has become increasingly substantial. Obviously, due to the greater ease of use of photographic techniques, photographic archives are among the most useful tools for really understanding what was and what has been lost.

This study is based on all these aspects: the acquisition of all available information for the case study, the critical analysis of the transformations, the definition of the reconstructive hypotheses and finally gathering together of everything in an organized system. This type of cognitive process inevitably leads to the scientific verification of the collected data and consequently the construction of a database that contains all of the elements. It served to substantiate the phases of reconstruction of the three-dimensional model.

This virtual archive will be implemented from time to time, updated with new acquisitions needed for the three-dimensional reconstruction of the district, an operation aimed at returning significance and value to an urban space which unfortunately no longer exists, as well as learning about it and making this knowledge available to the public.

The proposed case relates to the demolition of the *Alessandrino* district in the 1930s, with the subsequent development of the huge open space that was created and the consolidation of an urban void that has never actually been filled: the green spaces, the parking areas and the majestic

road system have never made the area liveable. It was a place from where one could see the ruins of the great empire, and the excavations that have taken place in the area in recent years have attempted to bring to light, at different levels of stratification, the history of the district.

Three different levels have been defined in the reconstructions. The first and most philological due to its copious documentation, is a 3D model that is very true to life. A second reconstruction, which requires a partial interpretation, comes from documents offering either the perspective drawings only, or the site plans only. The third reconstruction, on the other hand, is one that less coincides with the real historic shape.

In this third case, the absence of archival documents was an obstacle, however it was overcome and justified through the use of the area's building "types", starting with a documented base concerning the heights and numbers of plans obtained from land registration documents (called *brogliardi*).

The virtual reconstruction of *Alessandrino* is a complex and complete study that touches on several disciplines: urban planning, architecture, archaeology, restoration and sociology. Furthermore, this virtual reconstruction is unquestionably of great importance for understanding fully the profound changes the area has undergone and for realizing the artistic and architectural losses suffered by the city.

2. The Alessandrino District

The area on which we are addressing our interest coincides with the area of the Imperial Fora. During the city's imperial period, in this area, which was also geomorphologically central with respect to Rome's original urban system, the political, administrative, commercial and cultural activity was concentrated, giving life to the complex and articulated system of Fora.

In medieval times, interest in these places waned and activities moved on toward new systems of territorial management. These monumental structures were also gradually abandoned, relegated to the margins of the urban morphology that the city was assuming. Over the centuries, disuse and neglect led to the transformation of the spaces, which were gradually reclaimed and "degraded" to agricultural use.

Recent archaeological investigations[1] have revealed the presence of gardens on the terrain that were deposited on top of the ancient marbles and small houses. Traces of these *domus terrine* and *domus solarate* are still evident, but notably the paths to the interior of the old Fora no longer exist to link the original layouts due to functional requirements for connecting the parts. Some of the most important of these are described in the processional itineraries from the eighth century onwards (First, the *Argiletum* which progressed up to the church of Sant'Adriano and from there to the *Clivo Argentariorum* and then, in the twelfth century, also the current Grillo ascent and its connection to *Via Lata*).

A beautiful image contained in the *Codex Escurialensis* represents this portion of the city as it would have appeared in the second half of the 15th century (Fig.1). The *Torre dei Conti* (Conti's tower) is located in the centre of the drawing and overlooks a wide, perhaps cultivated field, with a small built up roadstead around it against the background of the *Rione Monti* (Monti district) towers[2] and the remains of ancient monuments. The state of ruin is also reiterated in another drawing from the anonymous Escurialensis with the Temple of Minerva and the Arch of Pantani in the foreground.

Fig. 1: The district on an image of the Codex Escurialensis that shows the quantity of towers present in the area

The physiognomy of the district seems to be already outlined on the whole in the panorama of Rome by Giovan Battista Falda of 1676 (Fig.2), a

[1] R. Meneghini, R. Santangeli Valenzani, *I Fori Imperiali. Gli scavi del Comune di Roma (1991-2007)*, Rome 2007.

[2] The presence of baronial towers marked the area, which, especially with respect to the area of the Forum of Nerva and Temple of Peace had, in around the year 1000, already assumed the name Campo Torrecchiano.

configuration later confirmed by a drawing by Nolli of 1748 (Fig.3), where the stately palaces and the numerous churches are also indicated.

Fig. 2: Portion of the Rome Plan by Falda of 1676, which shows the density of the district

Fig. 3: Portion of the Rome Plan by Nolli of the 1748, which shows the blocks and the public spaces

Even more detailed is the description found in the Gregorian urban cadastre (Fig.4), a tool that is essential for pursuing the goal of the research. Here the parcel division and the description of the free areas has been added. Consulting the cadastre for that of the relative land registration documents (*brogliardi*) allows us to recognize the existing building types in the area and the consistency of the building fabric. In the cadastral updates made in 1871, the district's construction appears denser, some portions of the interior areas are filled in and some parcels have been recast. From the archival documentation, especially title 54 and the Building Inspectorate kept in the Capitoline Historical Archive, it is clear that interventions implemented in this period mainly concerned erections, restorations, alignments, some rebuilding and restructuring of facades.

Fig. 4: Portion of the Gregorian urban Cadastre, 1824

But the situation outlined in these cartographies is intended to be revolutionized by the post unitary urban planning choices. These choices already from the drafting of the first regulatory plans traced the urban fabric with yellow lines of demolition. The opening of via Cavour was the first intervention that marked the beginning of the transformation. The road from the Termini station makes a straight line across the *Rione Monti* (Monti district) and descends to the Roman Fora where it momentarily stops.

Meanwhile plans to connect *via Cavour* to *via del Corso* followed with proposals for variants. At the same time historic buildings were demolished

adjacent to the Capitoline Hill to make way for the monument to Vittorio Emanuele. The variants to the *Piano regolatore generale* (General Regulatory Plans) of 1909, 1924 and 1925-1926 would decree the demolition of not only the buildings overlooking *via Cremona* in order to enlarge it, but also the entire neighbourhood overlooking the Imperial Fora. The strategic plan of 1931 only defined the limits and sanctioned the demolition, which was actually already in progress[3]. It mapped out the route of the new road which was changed during construction (Fig.5, 6).

The *Via dell'Impero* was inaugurated on October 28, 1932 and opened definitively in April of 1933 (Fig.7).

The work that led to the disappearance of the Alessandrino district was thus completed with extraordinary speed, and although a photographic and documentary campaign of the demolitions was planned, this turned out to be unorganized and incomplete. In 1927, Antonio Muñoz, President of the International Artistic Association, organized an exhibition in via Margutta because: "Photographs are excellent research elements: they are documents to be archived, not exposed in a museum... "

Fig. 5: Demolition of the portion included within exedra of Trajan's Forum. It is still visible the ancient street Alessandrina and the buildings on it

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[3] For the temporal sequence of the various phases of the work and the ongoing cultural debate at the time see: A.M. Racheli: *L'urbanistica nella zona dei Fori Imperiali: piani e attuazioni (1873-1932),* in L. Barroero, A. Conti, A.M. Racheli, M. Serio, *Via dei Fori Imperiali – la zona archeologica di Roma: urbanistica, beni artistici e politica culturale*, Rome 1983.

Fig. 6: Density of the urban fabric in the Alessandrino district

Fig. 7: The area after the demolition. Via dell'Impero was inaugurated on the 1932

Many critical voices moreover were raised at the time with regard to the operations that were being undertaken. They can be followed on the pages of the journal *Capitolium*. These were destined, however, to be silenced by the obligation to submit to the will of "Il Duce" (the Dux Mussolini), who loaded the construction of *Via dell'Impero* with symbolic meanings and a disregard for the enormous sacrifice in terms of the city's architectural and cultural heritage. Also and above all the effects were felt in social terms: around 4,000 people lost their homes and moved into so-called "provisional" villages, which were at the time lost in the middle of the countryside - Val Melaina, Tormarancia, Primavalle, Gordiani, Pietralata, San Basilio, Prenestino, Tiburtino.

We cannot return the houses to their original owners, but we can bring back, through research and documentation, an image of those places that are witness of a past. In this way, we can recover

that urban fabric that "vanished prematurely", reassembling the physiognomy and texture, returning to that place a part of its own past.

The image that we intend to represent is the one immediately preceding the demolitions.

The archival research finds positive results in the collections kept in the Capitoline Historical Archive. In addition to the aforementioned collections of Title 54 and the *Ispettorato Edilizio* (Building Inspectorate), the documentation in the collections relating to the various items of the Piano Regolatore (Master Plan) is precious. It would be extremely useful to be able to consult the documents of the Ex-V allocation (technical services), but the Archive, managed by the City of Rome, is only partly catalogued and concerns, at least with regard to the object of the study, areas that cannot be visited for incidental reasons that will continue for some time (Fig.8, 9).

While waiting to review this documentation, we also made use of photographs held by the Museum of Rome, recently published[4] in their entirety and, of course, the information contained in the 1871 updated version of the Gregorian Cadastre which describes the state of the area just before the demolitions and is useful for filling in the documentary gaps with the architectural interpretation of building types, comparing them with those already observed and analysed in the surrounding areas.

Fig. 8: Archive documentation: ISPETTORATO EDILIZIO, PROTOCOLLO 6097, Particella 1585. Front Elevation, watercolored, with precise information about the aspect of the building before the demolition

Fig. 9: Archive documentation: TITOLO 54, PROTOCOLLO 13959. Sometimes it is possible to have only few information about the building: only plans, or only elevations. Sometime nothing is possible to search out

3. The Geo-Archive as information infrastructure for knowledge management and valorisation of the region

In recent years, the evolution of the sciences which deal with the representation and sharing of information has accelerated due to the increased use of geographic information systems. Geographic information, organized in the mesh of relational databases, also integrates the historical knowledge to the extent that the thematic data archiving and the dynamic representation of the data facilitate the reconstruction and connection of the traces, visible and interpretable, of the passage of the communities which over time have made and unmade it their living space.

The archaeological area and the historic city examined by this study (existing and to be reinterpreted) constitute privileged areas of experimentation on the potential for a logical construction process of the real-life model, reducing it to relationships between information and the subsequent selection of data to be implemented in order to process it and link it together. In different ways and with different perspectives, they constitute textures of coherent and structured signs that on the one hand, expose intrinsic rules and on the other suggest lines of development.

The role of formalized representation emerges in all its cogency with respect to these themes and stresses the need to develop a representation of reality that is easily transmittable.

Standardization, storage possibilities, accessibility and transferability of information are all part of a single and overall condition of

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[4] R. Leone, A. Margiotta, F. Betti, A.M. D'Amelio (ed.), *Fori Imperiali. demolizioni e scavi. photographs 1924/1940*, Milan 2007; R. Leone, A. Margiotta, F. Betti, A.M. D'Amelio (ed.), *Via dell'Impero. demolizioni e scavi. photographs 1930/1943*, Milan 2009.

extension of the database of shared knowledge of the past and present urban reality.

In this sense, the progressive and growing evolution of storage systems and the selection of information have made it easier to enter the data into WebGIS and the geodatabases, limiting it to a representation of the architecture, the city and the region that is mediated by the data.

Therefore, if in the sphere of knowledge the efficient management of data is a condition for the preservation of stratified values, in the sphere of action it is a prelude to the possibilities and the rules of its modification. Concerning the first point, the community is the recipient of the product and therefore the subject from which we expect a surplus of consciousness of the region, the landscape and the cultural heritage, while in the second it is the government, inasmuch as the government is responsible for the formation of the broad territorial policy, the recipients of the ordered representation of the urban space, the instrumentation that provides them with the most effective tools and consequently greater responsibility.

Within this framework, stages of formation of the tool for representing the urban reality are identified and positioned with regard to the case of the reconstruction of Via Alessandrina. A system of archives with different content and ordered functions for selecting relevant information from time to time with respect to certain purposes, it is a tool for which the GIS, with all its branches and applications, is the most effective platform.

4. Technical and technological aspects

The formation of the relational databases to be used for representing Via Alessandrina through its relevant objects is divided into several different phases and steps, sometimes consecutive, sometimes simultaneous, which are summarized below.

1. Unification of the reference system of the database elements, assuming the Italian geodetic system. This is the necessary condition so that the archive contains information which is available on multiple, spatially compatible layers and can be connected to other archives.

2. Adherence to Italian and EU law in the use of open source platforms, in particular the **RDBMS** (**R**elational **D**ata Base **M**anagement **S**ystem) type of geodatabase, for the formation of geographical databases, also in response to the connection, extension and file-sharing needs of the same archives. Open source platforms provide free licenses for passive and active users, and have proven reliable and easy to use.

3. Implementation of the GIS-based archive and three-dimensional and two-dimensional representation of objects constituting the urban fabric under study with a specific indication of timing and of belonging to specific cultural climates, figurative experiences and anthropological structures.

4. Transfer of models on WebGIS and access management. The purpose of the instrument is the communication and dissemination of information as built into its relational structure. The integration of functions of representation and spatial analysis of GIS in the geo-archive allows for the activation of advanced representation and modification functions of the territorial entities arranged on multiple cognitive-informational layers. It has proven useful for common, professional and institutional users, who access the different levels of information with increasingly restricted access.

5. Formation of virtual reality models for navigation within the re-created space. Numerical cartography and surveys of the constructed space, appropriately integrated with *laser-scanning* technologies, will be unified as to their numeric matrix and geo-reference in order to ensure that the realization of three-dimensional models contributes to the formation of a more general unified and coherent territorial archive. The level of depth and realism of the three-dimensional representation is one element of the communication and formation of a diffused consciousness at the level of common use, while the quality of the data and information that can be derived from their combination will have more significance in the technical-scientific setting to which researchers, professionals and administrations have access.

6. Systematic coordination and connection of all the activities of a) data storage, b) construction of information and c) formation of representations which are to be updated in real-time simultaneous to the extension of the information base. The GIS is actually the unitary platform that integrates *hardware*, *software*, content, services and user responses.

5. A philological and emblematic virtual reconstruction

To make a careful reconstruction of the Alessandrino District, the Gregorian Cadastre of 1871 was used as a graphical base to support isolated models, and a reconstruction of a three-dimensional model of the terrain appeared immediately necessary. The modelling of the topography of the area examined has resulted in a thorough and careful review of historical and contemporary maps and at the same time a photographic control in n points which had sufficient documentation.

The topographic trend has been recreated by a cloud of points derived from maps, assigning to each point listed the respective height on the z-axis (Fig.10).
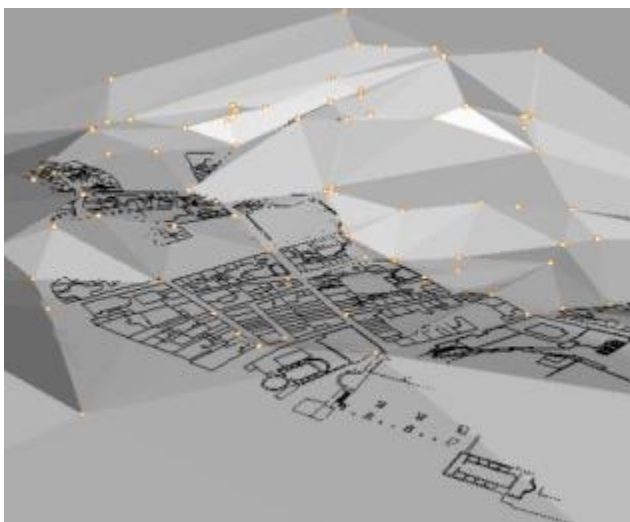

Fig. 10: The first 3D topographic model. At every vertex there are the known altimetric points taken from the archaeological map of Lanciani

The surface obtained conforms and coincides with the assigned points. However there are limitations in all areas between the points, where obviously the reconstruction is done by interpolation, adjusting the surface of the terrain

in a way that is more consistent with the data provided. It is clear that we cannot have, today, all the historical altitudes of road or planking levels: the topographical aspect has greatly changed over time, and the reconstruction relates only to the data available today.

Another issue that is being addressed is the drawing of the archaeological remains emerging at the time when the Gregorian Cadastre was made (1871) and that were still not restored. This is a very sensitive and complex theme.

Another point is the reconstruction of the historical documentation.

The actions carried out are as follows.

Cataloguing of the archival material available and indication on the map of the referenced parcel. In this regard, one can cite the use of an archiving system agreed upon with the dipsuwebgis[5] referent in order to enter the documentation onto this computer platform at a later time.

Fig. 11: Re-traced the documentation allow us to redraw the plan of some bloks in digital, helpful to start the 3D model of the area

The reconstruction of the wall survey of the street levels is an operation that requires interpretation (Fig.11). We face choices from time to time which are difficult to insert in a protocol, and also in this case we chose to insert the project site plans (always because they are the closest to the

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[5] The project 'DipSU WebGIS' (modified recently in Descriptio Romae) aims to create a system WebGis OpenSource for consultation via Web of cartographic databases produced by the Department of Urban Studies. The system has as pre-basic requirements the use of open source solutions and products and adherence to the WMS specifications of the Open GIS Consortium for the publication of information on the web.

consistency of the building before demolition). Furthermore the documentation contains graphics that are not always uniform. Sometimes instead of the street level plan being present, other site plans relating to the plans where the transformation for which the permit is requested occurs.

These are, however, re-traced and inserted in the general site plans at different layers (Fig.12).

They are nevertheless useful for identifying spine walls, stairwells and the location of openings so that, even if it would be possible to formulate hypotheses sufficiently founded on the shape of the ground level, we chose to represent the available plan.

Another choice was needed in the absence of plans but presence of front elevations. In such case the location of the openings are indicated on the plan, but the drawing of the parcel's interior development is not done.

The design of the street facades should be in according to the principle of authenticity. Regarding the historical documents in which there are two drawings of the building, one of the current state and one of the project of modification (as for example a raising of one or two floor), we preferred the second, assuming that, if it has actually been achieved, it would correspond better to the state prior to the demolitions. In the case of the Alessandrino District, in addition to the archival documentation, the photographic documentation is sometimes also present, which is assumed to be unambiguous data for the reconstruction of facades, when it is evaluated and compared with existing documents.
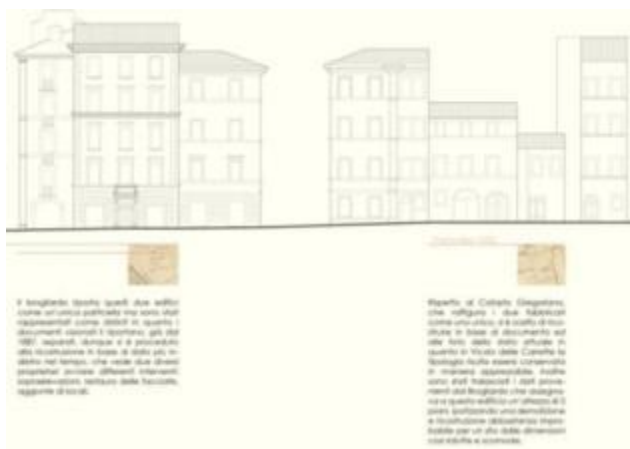

Fig. 12: Re-traced the elevation of the buildings in digital for a future archive.

Based on the re-traced drawings, we continue to realize a 3D digital model consistent with the bibliographical sources.

The more information that can be taken from the archives, the more detailed the model can be. Due to the inevitable archival gaps, it was decided to bring together, in the same reconstruction, very detailed models (to a scale of approximately 1:50) with much simpler reconstructions (at a scale of 1:200) where the reconstruction is not philological but occurs for similarities with similar building types.

However, so that the type of reconstruction is clearly recognizable, different colors are assigned at three different levels of reconstruction (Fig.13).
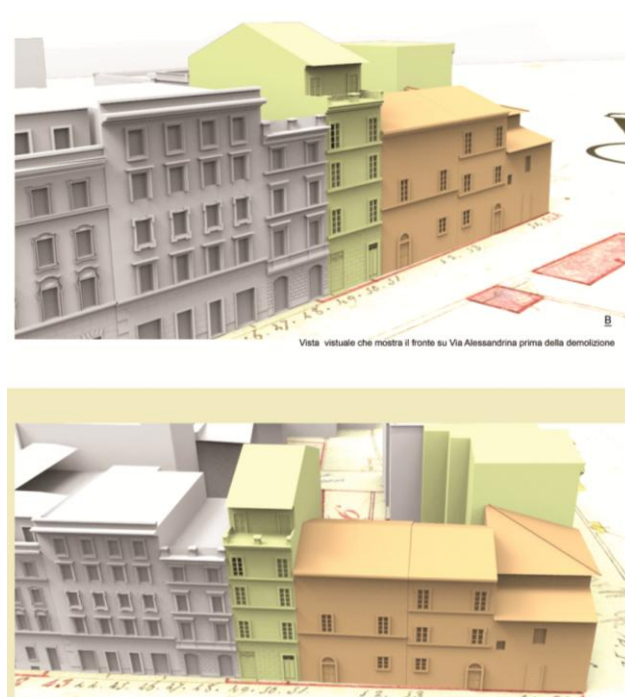

Fig. 13: 3D model of the district. The three different types of reconstraction are highlighted with different color.

6. Scientific and technological impact

The effective integration of all data available for a given site, archives, two and three dimensional and much more useful for an adjustment to the directives of the London Charter, for the digital display of cultural heritage, and it attempts to establish both the principles for the use of methods of displaying digital but also to fix the results for the research and the communication of cultural heritage. Will be indispensable to verify data subtended in order to: Determine an intellectual rigor, scientific and

technical use of such data; make sure that the display and the procedures computer-based can be properly understood and valued by users.

The research also reflects the desire to conform to the guidelines of Horizon 2020 whose aim is to achieve by 2020 a single and open European area of online research in which the researchers (and not only) can enjoy the avant-garde and services to create a network to access open environments for e-science and global banks of digital data.

The case of the district of Alessandrino is a novelty: nobody has ever systematised the documentation of existing archive, and is one of the cases-study more interesting on demolition at an international level; the decision of break it to the ground, was taken under only need a triumphal entry in Rome, without keeping in mind the historical value. The thorough study and the results obtained viewable as timeline will return value to a vacuum urban torn (Fig.14 to 18).

A study concerning the application method on cases study can be repeated on other topics: in all the cities there are traces of lesions and lacerations caused by various events, including the archaeological theme.

The possible use of such an integrated digital archive is branched and desirable for the superintendents, the municipal offices, the local entity, the state archives but also to individual citizens.

Modernity and technology will have a strong valence in all stages of research: digital acquisition of archival data and surveys; processing the computerized data; broadcast of the results obtained through the use of instrumentation avant-garde, but accessible to all, thanks to the technologies for augmented reality on smartphone, tablet, readers of QR code.

7. Conclusion

The new generations are accustomed to receive information quickly through the network.

For this reason, the help of a digital networking makes possible to have data with immediate usability.

Citizens can, in this case, linked to a historical heritage that would enable them to read the present, the order of the territory and the social configuration, in a modern key.

This awareness is connected to economic and cultural aspects , with the ability to provide these data through more than 600 points hotspot in Rome.

The significance of this work is to offer design solutions that can improve the contemporary use of the Fora without removing, but rather rediscovering, the paths that for centuries overlapped the preexisting ones which, already starting from the medieval era, had allowed people to cross the area.

Along these paths appropriate displays could be installed, which, with the help of new technologies, would allow the exploration of the area in the succession of the different historical phases.

Scientific research would therefore become functional to the revaluation of a cultural heritage that has disappeared, making the results accessible not only to the interests of of the institutions but also to the curiosity of the citizens.

Fig. 14: 3D model of the Alessandrino district on the adjusted topographic model

Fig. 15: 3D model of the Alessandrino district on the adjusted topographic model. Section

Fig. 16: 3D model of the Alessandrino district on the adjusted topographic model. Section. Detail of two blocks

Fig. 17: 3D model of the Alessandrino district. Street view

Fig. 18: 3D model of the Alessandrino district. Street view. Elevetions on Via Alessandrina, corner with Via della Croce Bianca.

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