THE TRACES OF THE PAST: INFORMATIVE TOOLS FOR THE RECONSTRUCTION OF AURELIAN WALLS IN RIONE TESTACCIO

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Commission II, WG II/8

KEY WORDS: Aurelian Walls, Testaccio, Analysis, GIS, Mapping

ABSTRACT:

Rome has a great cultural heritage, formed by the stratification of styles and political influences from different eras. The different eras and architectural styles that have defined the city in the two millennia of history, make each part unique in its kind. This succession of changes has by necessity led to the denial of some archaeologies that in past ages were pivotal points in the development of the ancient city. The research presented here is intended to analyze and reconstruct the archeology of the river stretch of the Aurelian Walls on the Lungotevere Testaccio partly disappeared from the architectural landscape of the city. The research was set in two main phases, the first based on the two-dimensional study of the lost fabric, focusing on the cartographic study and the digitization of them in the GIS environment. The second one still under development foresees the digitalization of the three-dimensional elements detected and the insertion of these within the dedicated platforms.

1. INTRODUCTION

The city of Rome appears as a succession of stratifications that have led to the formation of a unique architectural panorama in the world. The different eras and architectural styles that have defined the city in the two millennia of history, make each part unique in its kind. This succession of changes has by necessity led to the denial of some archaeologies that in past ages were pivotal points in the development of the ancient city.
The research presented here for this reason has the purpose of analyzing and reconstructing the archaeologies partly or completely disappeared from the architectural panorama of the city.
The research has been under development for years within the Department of Architecture of the Roma Tre University, where the urban fabric of the city of Rome is studied at different scales of representation. (Cianci, 2016). The theme with which we deal in this article combines two parallel lines of research, the first focusing on the study of the ancient Roman route of the Aurelian Walls, the second the demolitions and the changes that resulted in the construction of the *Muraglioni* of the Tiber river.
In fact, after the appointment of Rome as the Capital of the Kingdom of Italy, a series of interventions began to make Rome a city designed to accommodate all the functions of a state's capital. In this period, therefore, we begin to talk about the unfolding of the historical fabric of the city, with the function of public utility or to make room for new places of representation of the new capital of the Kingdom of Italy. Interventions that then in the Fascist period will continue radically changing the face of the city, eliminating important historical remnants. We must not think about the demolitions and the destruction of the fabrics of the historic city only as changes that have canceled the historical heritage of the city, but also as interventions that have selectively brought to light the fragments of past eras that over the years were long lost.
We defined Rome at the beginning of the paragraph as a succession of stratifications that over the centuries have gone on to add, cancel and coexist to give the city a unique appearance. (Accatasto et al., 1971) In some cases the archaeological excavations, brought to light the finds of past eras and the construction of new infrastructures have imposed arbitrary choices that have given a new face to the city. (Figure 1).

Specifically, the research is aimed at studying the Aurelian Walls river route, redefining their geometries, through today's tools of analysis and digital reconstruction. The area of study concerns the external walls on the Lungotevere Testaccio, whose northern route has been completely lost and only a few fragments remain of the South. Being a vast study area, which include the territory between Ponte Sublicio and Via del Porto Fluviale (2km), the methodological approach through which the research was developed was divided into four distinct phases:

- Cartographic and historical research
- Systematization of study materials within GIS platforms
- Survey of the findings
  Interpolation of GIS systems and three-dimensional models

Figure 1. Historical photo taken during the excavations that brought to light the ruins of the *Emporium*. From the photographic archive of *Roma Sparita*

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2. THE AURELIAN WALLS: THE STUDY AREA

The history of Rome is closely linked to the spatial development of its city walls, for millennia it has been an element of protection and containment of the historic city. The walls are one of the few elements that allow us to understand not only the spatial development of the city in the succession of eras but the political development as well. The boundary wall, wanted by the emperor Aurelio, was going to replace the now disappeared layout of the Servian Walls, dated six centuries before the beginning of the works wanted by the emperor.
For many centuries the Aurelian Walls, were one of the least studied anthropic presences of the past, present within the city of Rome. Only starting from 1930 targeted studies began, aimed at understanding the construction history of this ancient route. (Colini, 1944) With these studies the two main construction phases that led to the birth of the entire path were identified. These two phases were followed by reinforcement and elevation interventions over the centuries, using different materials and construction techniques. The Aurelian Walls are one of the longest ancient city walls, 18 km and were built by the emperor Aureliano between AD 270 and 275 Over the centuries they have undergone restorations and expansions becoming among the best preserved in the world. (Richmond, 1930) The structure of the walls was composed of a cement core with a thickness of approx. 3.7 square meters with an elevation of approx. 7 m, above a thicker cement foundation. The height of the structure reached approx. 8 m considering also the crenellated parapet. The city walls were interspersed with 400 sighting towers 100 Roman feet away from each other. (Mancini 2001) The length of 18 Km also takes into consideration the river walls upstream of the Tiber river. The dating of this stretch of wall remains uncertain, as the construction type used seems to be posthumous with respect to the original Aurelian layout, making the study of that stretch of great scientific interest. (Figure 2)

Figure 2. Model of the Testaccio area, 1849 ca. Used by the French army for the campaign of 1849. The external route of the river stretch of the Aurelian Walls and the internal route to protect the fields are highlighted. From the photographic archive of *Roma Sparita*

With the development of the industrial zone in the southern part of the city (approx. 1888), the ancient Rione Ripa today Rione Testaccio, and the construction of the embankments of the Tiber river (1876-1926) a part of the route of the walls and the relative port of Ripa Grande have disappeared from the architectural landscape of the city. (Insolera, 2011) To date, some elements of the ancient layout of the walls remain in sight, such as a defensive tower and tracts of foundations. On the final stretch of the river walls was the Emporium, built in 193 BC following the necessary expansion of the Foro Boario port. The construction of this new port is the cause that led to the formation of Monte Testaccio, called Monte dei Cocci (Potsherds Mountain). The Emporium was in fact the main point of arrival of the amphorae containing oil, wheat and other raw materials and the sorting of these amphorae has led over the centuries to the accumulation of an estimated number of about 25 million amphorae (Calisi and Molinari, 2017). The port unlike other architectural elements was discovered with excavations for the new embankment of the Tiber river in 1868. To date it is visible for a stretch of 500 meters and part of the structure is embedded within the embankments of the river.

Figure 3. Historical photo taken during the construction of the Tiber river wall. Excavations have unearthed the remains of the *Emporium*. From the photographic archive of *Roma Sparita*

Understanding the geometry of the archeology lost over the centuries allows us to obtain a digital database of the architectures that over the centuries have defined the city of Rome. Specifically understanding the development of the Aurelian walls, it also allows us to understand the original orography of Ancient Rome by going and defining the reasons for their construction.
Specifically, that part of the walls along the river had not been erected only for defensive purposes but also to control and manage the floods of the Tiber. The artifacts that remain visible today, in particular the sighting tower, are not all dated to the original structure, but in some parts are dated to the late medieval age. At that time, more than 26 restoration and extension works were filed. In particular, the tower follows the architecture and functionality of the ancient Roman tower. (Coates, 1999). The walls of Rome are a topic of study that is still largely unexplored, developed mainly through specific analysis of individual artefacts or of the structure as a whole. From the nineteenth century, with the rediscovery of the archaeological heritage, studies focused on the walls of Rome began. Given the nature of the studies, aimed at individual elements of the wall system, there are still unclear elements, as some of the surviving walls remain to be interpreted. In particular, the area adjacent to Monte Testaccio had a smaller boundary wall, which bordered the Via di Porta San Paolo and the Vicolo della Serpe, skirting the Monte and then reconnecting to the layout of the Aurelian Walls. This wall protected the fields present between the slopes of the Monte dei Cocci and the bank of the Tiber, although it is almost comparable to a wall it is possible through the analysis of some engravings to find the presence of some sighting towers.

3. THE CARTOGRAPHIC STUDY

The starting point of the research work concerning the layout of the walls of the Lungotevere Testaccio is the study of archival documents and historical maps.
Rome is a city that in both planimetric representation and in bird's eye views has had different interpretations, depending on the sensitivity of the representative and the choices to put more or less in view some peculiar elements of the city. The presence of archaeologies of considerable importance has always partly offset these city visions, particularly in the pre-18th century representations, where monuments and archaeological findings within the drawing assumed greater importance.
For this reason, a first phase of study took into consideration bird's-eye perspective views, making an operation of comparing the elements, trying to find common determinants, which led back to a basic truth in the representation of the walls. The choice to operate in this way derives from the obvious lack of a planimetric scientific in the representation of Rome and therefore the impossibility of making a planimetric comparison of the elements. It is interesting to note that from the most ancient engravings the route of the Aurelian Walls has always been one of the main points of reference in the representation of the city of Rome. One of the most emblematic representations of Rome where the walls which are highlighted as an element that defines and represents the city is the plan of Paolo Forlani of 1563, where the Roman territory is represented from Civitavecchia to Circeo. (Figure 4) In this planimetry, the orography of the territory is mainly emphasized by means of three-dimensional elements, and the only presence of an anthropic element within the drawing are buildings designed to represent the city of Rome and the layout of the Aurelian Walls.

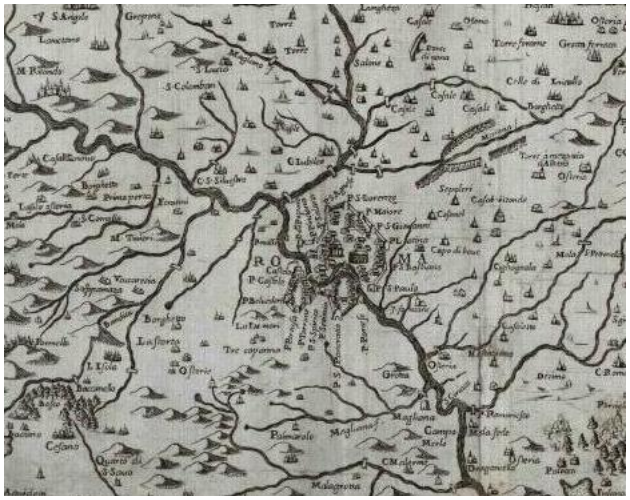

Figure 4. Planimetric excerpt by Paolo Forlani, 1563. Highlighting the layout of the walls that defines the boundaries of the city of Rome.

The perspective incisions examined for the knowledge of the tracing of the walls, through an operation of comparison and selection are: the Map of Rome by Sebastiano di Dosio of 1561 (Frutaz, 1962), Map of Rome by Hogenberg Franz of 1575 (Braun and Frans, 1966), Map of Rome by Paulus Merula and Pirro Ligorio of 1600 (Huelsen, 1933) and the *Novissima et acuratissima delineatio Romae veteris et novae, in viatorem usum et commoditatem* by Giovanni Battista Falda of 1676 ca. (Graevius, 1732). Interestingly, as in these examples the spatial development is always very similar, the number of sighting turrets in that section is not always constant, but in the two most reliable maps it corresponds.

The map of di Dosio (Figure 5) presents a view of the city of Rome seen from the North, setting it as the vision of Rome seen by a traveler entering through the ancient Via Flaminia. In this map the sighting towers are accurately represented on the whole route of the Aurelian Walls and there are 8 in the area that covers the Lungotevere Testaccio. The protective field walls are still missing, starting from the end of the river walls and reconnecting to the Aurelian Walls passing the Monte dei Cocci.

Figure 5. Map of Rome by Sebastiano di Dosio of 1561. Engraved in bronze by Sebastiano Re de Chioggia after Giovanni Antonio Dosio.

Unlike the map of di Dosio the one of Hogenberg Franz of 1575, presents a vision of Rome from the West. (Figure 6) These different points of view derive from the fact that only in the nineteenth century the standard for the representation of plans will be set with the North towards the top of the map. In this case the river walls of Testaccio are not fully represented, but tend to disappear, leaving only a part of the track in evidence with 6 sighting towers

Figure 6. Map of Rome of Hogenberg Franz, 1575

The representation of Ligorio and Merula (Figure 7) instead is of great interest to understand the spatial development of the walls. It is of interest not because it represents a true view of the city of Rome at the time, but because it reinterprets the development of the Aurelian Walls and connects them to the Severian Walls. The track of the latter already disappeared at the time of the construction of the Aurelian Walls.

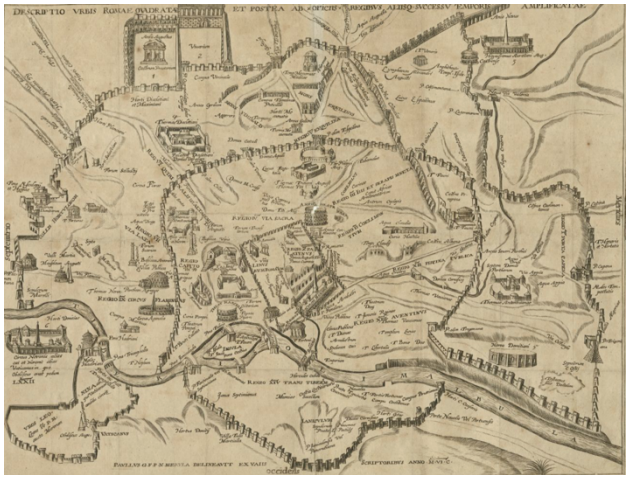

Figure 7. Map of Rome of Paulus Merula e Pirro Ligorio, 1600

The representation of Giovanni Battista Falda (Figure 8) is one of the most truthful, so much so that already at the time of its publication it was considered the updated version of Tempesta's drawings. The attention to detail and the scientific nature of the representation leads it to be one of the most detailed maps of Ancient Rome. Specifically, regarding the area of Testaccio, it is the only map mentioned in the text to represent not only the external walls but also the inner walls of the fields. The great amount of detail of representation not only of the external walls but also the internal features are one of the common denominators with the map of the Tempesta. (Borsi, 1986) Unlike this one, however, given the temporal offset, it represents the walls in a state of abandonment, representing 5 sighting towers and what appear to be the remains of three other destroyed areas.

Figure 9. *Novissima et acuratissima delineatio Romae veteris et novae, in viatorem usum et commoditatem* of Giovanni Battista Falda, approx. 1676

It should be remembered that the towers on that stretch of wall were not the original Roman ones, but had been rebuilt, partly mimicking the Roman construction technique in the Middle Ages.

The plans used instead for a more accurate study through historical overlap and documentation and which then were digitized are The New Map of Rome by Giovan Battista Nolli, (Nolli, 2016) the XLIV Table of the *Forma Urbis Romae* by Rofolfo Lanciani and an extract of the Gregorian land register. The Nolli, for its precision and scientific in the representation is one of the most useful tools for analyzing the Roman fabrics of the eighteenth century. This is because it represents the spatial development of Rome with precision that was not common for the time. It also represents the city before the most important and impacting developments on the fabric.
The overlap of the Nolli, with the Lanciani instead allows to have an overall vision with the correct and only in some cases erroneous presence of the findings of Roman age up to the V century A.D. therefore including also the layout of the Aurelian walls.

4. DIGITIZATION AND GEOREFERENCING

Since the end of the 1900s there has been an increasingly growing interest in the development of multidisciplinary platforms that allow for more information to be contained than an element represented. This is where the GIS platforms are inserted, a tool that is by now established and commonly used in territorial planning. GIS is the acronym for Geographical Information System. The importance of this work method lies in integrating simple forms with information that goes beyond the geometric definition that could be given. It is therefore of great interest to try to understand how this work methodology can be integrated with traditional survey techniques, based on 3D laser scanners and photogrammetry.
As explained in the previous paragraph, the plans used as a reference for the study of the planimetric development of the walls in the Testaccio district were: The New Map of Rome by Giovan Battista Nolli, the XLIV Table of the *Forma Urbis Romae* by Rofolfo Lanciani and an extract from the Gregorian land register relating to the area of interest. The Nolli plan is an excellent starting point for the digitization of the walls in that although it is dated to 1748, the precision once georeferenced is impressive. The basis used for the digitization of historical plans is the Regional Technical Charter (CTR), scale 1: 5000. The map, besides being an excellent starting point, is also available through the OPEN DATA portal of the Lazio Region in GeoTiff format, which can be downloaded free of charge. GeoTiff is a type of metadata that allows you to incorporate geographical references into a TIFF image. It can include: ellipsoids, datum, coordinates, and everything else necessary to establish the exact spatial reference for the file.
It was decided to work on geo-referenced maps of the Lazio Region and consequently to georeference the historical maps within the single reference system (SR) ED50 UTM 33N, one of the most used in Italy and specifically in Rome. The SR used UT50 UTM 33N is based on European Datum 1950 in reference to the Hayford International ellipsoid based on Potsdam in Germany.
The whole georeferencing process was developed through a QGIS open source GIS platform. Georeferencing is the process of deforming a raster file that allows geolocation within a reference system. In the following research, the QGIS software *Georeferencer* plug-in was used based on CTR 1: 5000. In order to carry out this process it was necessary to do an overlapping of points between the current map and the Nolli map. The points must be known elements, therefore buildings that certainly have not changed their profile over the centuries. In georeferencing historical documents, it is necessary to take into account the imprecision that derives from it compared to the current documents made through satellite instruments.
To partially cancel this difference, a deformation must be applied to the image you have chosen to georeference. The degree of deformation used specifically in the case of Nolli is a polynomial of degree 1, so as to allow a correspondence

between the plans with a minimum percentage of error. The number of points in common for the geo-referencing of buildings ranges from a minimum of 3 up to a maximum of 9, depending on the deformation process used; the more complex the procedure the more points are required. Increasing the points does not necessarily result in a greater degree of precision, although the degree of polynomial deformation is increased.
The insertion of Lanciani's sheets was instead simpler, arranging import and geo-referencing using as the start file the dxf format was easier and more precise. The imported file was in fact made on the basis of the cad file of the ctr 1: 5000, thus already having a perfect correspondence between the two elaborates.
Only the geo-referencing process of the plans already allows to obtain results of great interest to understand the processes of change that have occurred over the centuries. The overlapping of the maps, with filters and different colors, allows to highlight the differences between the different types of fabric. An example is the areas of Largo Argentina, Via dei Fori Imperiali, Via della Conciliazione and Testaccio himself. The overlapping of the files makes it possible to instantly identify the fabrics that have been demolished or in the case of Testaccio built with the commissioning of the industrial district. (Figure 9)
This was the starting point for the work that will then follow the layout of the plans.

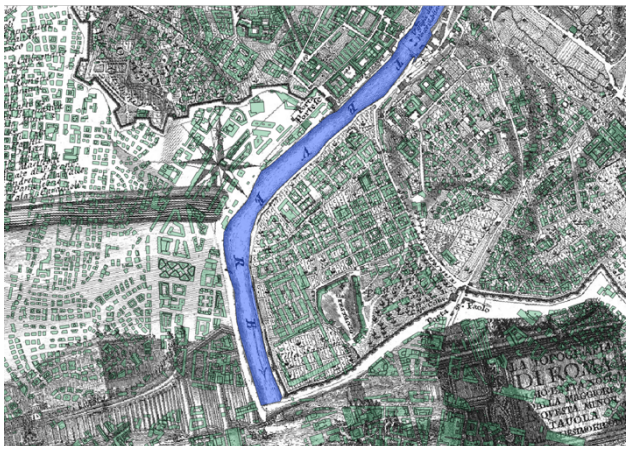

Figure 9. Overlap of the Nolli plan, with the vectorial fabric of the city of Rome extrapolated from the CTR 1: 5000. In the specific the image is a zoom on the Testaccio district.

5. VECTORIALIZATION OF THE TRACK

The fourth phase of the research concerns the revision and interpolation of the three previous phases within a single field of work. Specifically, the GIS platform becomes a container through links dedicated to different information. It is in fact possible to assign, through macro-internal actions to the software, data not only alphabetic and numerical but also photographic and three-dimensional models. In this way it is possible to navigate the two-dimensional map and interact with vector elements in different ways. (Boffi, 2004)
The GIS map has been set to be displayed at two different scales. The first on the territorial scale, reporting the entire layout of the Aurelian Walls, the second on a detail scale where are represented also the drawings of the sighting towers, differentiating between existing towers and destroyed towers.
In order to work on these different scales, more shapefiles have been created, each made using specific tools that best represent the object they are going to describe. Within the QGIS platform it is possible to use three drawing tools: point, line and polygon. Each of these is characterized by specific properties. The point does not have a geometric dimension, it simply indicates an element of interest on the map and it is associated with data and coordinates to be able to geo-reference it.
The line instead has a spatial development and the dimension of the length is added.
The Polygon increases the geometric characteristics by one degree, allowing it to have a closed shape and a measurable surface.
For the realization of the macro-scale map, two of the three instruments mentioned were used, the point and the line. (Figure 10). The line indicates the route of the Original Walls, which is also subdivided into a subset that contains the data that recognizes it as existing or disappeared. The path is therefore not unique but a union of several tracks with different information. The points have instead been used to indicate the presence of the entrance gates to the city, defining whether they exist or not. For the process and the scale of representation it was considered superfluous to draw the correct geometry.

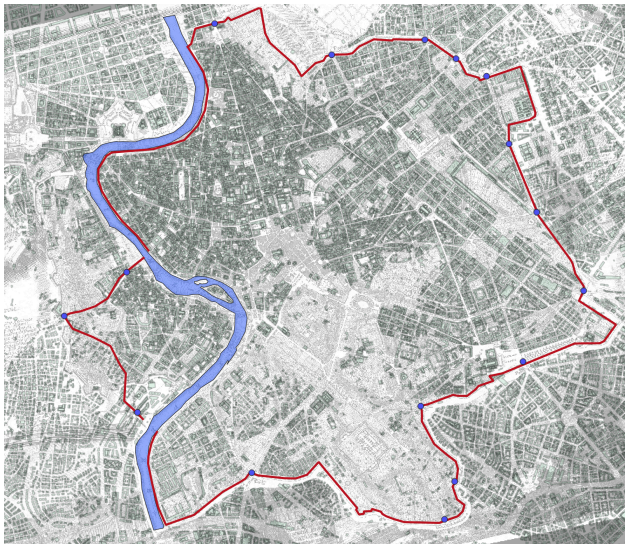

Figure 10. QGIS elaboration of the representation of the route of the Aurelian Walls and of the related entrance gates to the city. The ancient course of the Tiber river is also in evidence. In transparency the georeferenced Nolli plant and the fabric implemented extrapolated from the CTR 1: 5000.

The detail map instead, based on the macroscale one, uses all three instruments, adding the presence of polygons to identify the presence of the towers.
These too, like the previous ones, are differentiated elements for existing or demolished artifacts. Furthermore, a greater level of detail has been added, adding the boundary and protection walls of the fields to the slopes of the mountain which constitute a system of great interest that is connected to that of the Aurelian Walls. The data assigned are not only corresponding to whether a part of the walls is existing or non-existent but has much more information inside. (Figure 11)
It presents first of all cartographic references; therefore, it specifies where that tracing of walls, can be found in the different cartographies, reporting also an image. In addition, it also presents a continuously updated list of historical sources that the research continues to bring to light.
One of the most interesting parts is the connection to historical images found on digital archives, shared by the online communities and the archive photos in the literature.

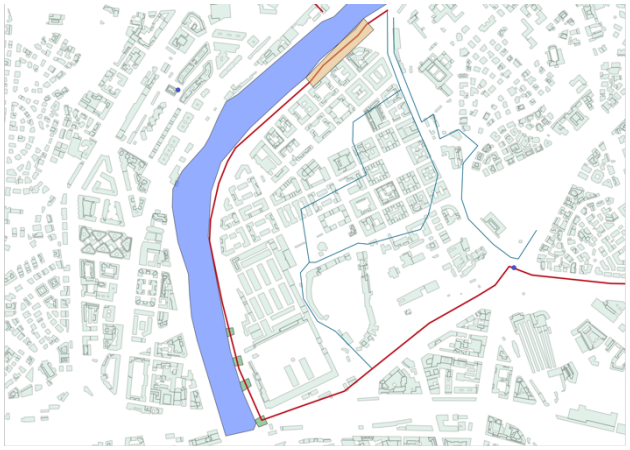

Figure 11. Detailed zoom on the WIP GIS map of the Testaccio area. Overlap with the ctr 1: 5000. In red the layout of the Aurelian Walls, in ocher the spatial encumbrance of the *Emporium*, in blue the now disappeared layout of the secondary city walls, in green, 4 of the turrets identified by cartographic and archival research.

6. DIGITALIZATION OF FRAGMENTS

Another step for the knowledge of the development of the river walls is the direct survey of the historical permanencies that are still visible today. Of the ancient track of the walls, only a few ruins remain, mainly in front of the Ex-Slaughterhouse. The most important element, partially intact, is the lookout tower built in the late medieval period. To this we add about 15 linear meters of walls, partly intact and the foundation of the foundations, which can be detected thanks to the natural quay of the Tiber river.

The process used to detect these remains was implemented with two different methods, the first through photomodeling, the second with a laser scanner campaign.

The two techniques, although they give the same result are very different from each other, the first uses photographs, recognizing the homologous points between them to reconstruct a dense point cloud of the detected object. The second, more precise, through a laser beam, creates a cloud, composed of millions of points on a 1: 1 scale. The substantial difference is precisely the final yield (Paris, 2010), if with the laser scanner a real model is obtained, on a 1: 1 scale with the photomodeling a model is obtained which will then be scaled according to a reference measurement obtained through direct survey.

Photomodeling, unlike laser scans, increases the degree of inaccuracy with changing atmospheric conditions and light and shadow ratios on architecture, impacting not only the precision of the reconstruction but also the final rendering of the chromatic texture of the detected object. The management of them is also very different, the point clouds produced by laser scanners are very heavy files, given the high degree of detail, due to the distance of points set during the campaign and many times it forces a decimation of the point cloud to put to work and study the detected element. Photomodeling allows for the creation of lighter and more versatile models that once the mesh process is completed correspond to true three-dimensional models. For the detection of single elements and fragments, the photomodeling has performed particularly well, but the use of the Laser Scanner has allowed not only to detect the object of study, but also to resume the terrain and therefore to be able to carry out a study on shares. Models that can then be integrated with the information produced by the GIS file. The photomodeling is the first step to have a starting model that allows then to model by analogy the missing elements that have been destroyed over the centuries. The survey process did not follow a purely digital methodology, but was preceded by a direct survey campaign, in order to have a starting point for setting the shooting stations for the survey campaign with photomodelling and laser scanner in the most correct way. (Figure 12) Furthermore, given that the model obtained from photomodeling is a non-scaled model, a double verification process was carried out by comparing the measurements obtained through direct survey and laser scanner survey.

Figure 12. Above, one of the work chuncks obtained by photomodeling, below a partial view of the point cloud obtained by laser scans

A factor to take into consideration is also the post-production work to be carried out on the individual models. Where with photomodeling the cleaning work is reduced, but in some cases, there is a work of reconstruction of mesh not recognized by the photograph, the laser scanner poses more problems of cloud cleaning. If the photomodeling is selective the laser filming resumes everything that the laser touches, and therefore exponentially increases the work of cleaning the cloud from objects not related to the relief and the natural components.

7. FUTURE DEVELOPMENTS: GIS E 3D

Working in the GIS environment, allows obtaining a didactic planimetry, where each element is associated with information. The GIS design processes are still strongly focused on a two-dimensional representation of the elements, both for the use that has been made of them to date and for the difficulty of working in a three-dimensional environment. A parallel research to the development of the three-dimensional map foresees the digitization of the detected elements and their re-elaboration in the field of Building Information Modeling (BIM), specifically H-BIM where H is the abbreviation of Heritage. An approach not aimed at parametric modeling of new constructions, but of the existing buildings for the realization of a complete 360 ° Information model. The integration between the BIM and GIS systems within the scope of the survey is still in the primordial phases, not as in the context of infrastructures, where through dedicated software it is possible to work in synergy with both work methods. (Borrmann et al., 2015). These two methodologies differ in the object of the modeling but not in the

approach used. Both work to assign metadata and information to geometries.
The approach being developed within the research is to assign non-information to three-dimensional elements, but the elements themselves become information added to the two-dimensional mapping obtained through the digitization of historical maps. The three-dimensional element is not modeled but is inserted inside the map as metadata which allows access to it through scripts, as can be accessed from various historical information. This allows not only to have a two-dimensional view of the element but also to understand its spatiality in elevation. The decision to proceed along this path also comes from the way in which the three-dimensional model is made inside the platform. To date, the model is created by assigning height parameters based on sea level. Each modeled element must be given a parameter that allows the software to create a three-dimensional geometry based on the zero dimension. This implies a high level of difficulty in modeling, given the non-constant orographic development of the terrain and the complex geometry of the anthropic element. After testing, in the modeling of vector and polygonal elements for the design of the walls and the integration with the DTM for the terrain model the results were not of a sufficient quality to allow understanding of the ancient route. This is partly due also to the net orographic change of the area where geography has changed radically over the centuries, thus not allowing a satisfactory integration. So, the three-dimensional model was inserted as a link, as is done for the insertion of photographic archives. The aim of the research is in fact to create an interactive plan with the purpose of a didactic element for the knowledge of the historical Roman fabric. In particular, the georeferencing of the walls and the three-dimensional model allows an added didactic element. Once the process of digitizing the existing finds has been completed, the future development of the research includes a work program aimed at modeling the missing elements within the lost route of the walls. A process that through the use of historical maps of reference and the elements still present today is aimed at a digital reconstruction by analogy.

8. CONCLUSIONS

The research presented here is one of the aspects of a line of research still under development within the Department of Roma Tre. The aim is to carry out the digitization of the most important historical cartographies, in order to create a database usable and usable by more than one skill but above all to create a three-dimensional model that can allow navigation within the neighborhoods and in the individual buildings. A concrete help, not only for the planning and understanding of the city, but also an instrument of historical memory that risks losing without the adequate resources. The virtual model is designed in such a way that it can be expanded and implemented with the continuous addition of information. In the case under consideration, working in the field of the Geographic Information System (GIS), allowed not only to obtain geometric elements of great interest but also to rework and create a computerized database that collects all the information found in the research phase. This work methodology, which is subject to a mixture of geometry of the territory and archeology and related data, allows for the creation of a database of analysis and surveys on a territorial scale, fundamental to move on to the detailed survey phase of the individual finds. This makes it possible to have geographical references at the time of the survey campaign (Figure 13) and once cleaned, it was possible to geo-reference them by exchanging data with the GIS database.

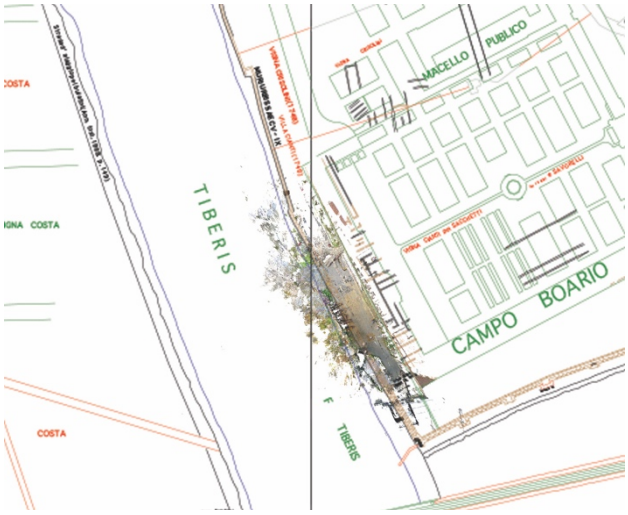

Figure 13. Overlap of the point cloud obtained by laser scanning, with the plan of the Forma Urbis of Rodolfo Lanciani

This work of data processing and reconstruction of the geometries and fabrics of part of the city of Rome is part of a wider research aimed at reconstructing the ancient aspect of the city.
Working in this area of representation has allowed us to diversify the design of the layout of the walls according to the year and the interventions implemented, by defining, through drawing tools inside the software used, the various categories of indexing.
The applications for this typology of research can be numerous, they are not simply expressed in a greater awareness of the urban scale of Rome but can also be used for the understanding and dissemination of the processes of transformation of the city through the creation of models and videos for installations museum. One of the first applications can be seen in the model of the Alessandrino district, exhibited at the Museum of Rome. (Cianci and Calisi, 2018) The model of the Alexandria derives from the departmental research “*Restituire l’identità perduta ai tessuti urbani storici. Metodologie innovative per la conoscenza e la fruizione del patrimonio culturale: restituzione ideale del Quartiere Alessandrino*”, Participants to the research: Maria Grazia Cianci, Elisabetta Pallottino, Francesca Geremia, Francesca Romana Stabile, Paolo Micalizzi, Daniele Calisi, Antonio Cimino, conducted within the Department of Architecture of the Roma Tre University. (Calisi et al. 2017)

The possibilities offered by the research are many, from an Open Source work methodology, open to more people and expertise to the drafting of a continuously updated WebGis, as the ultimate goal at the conclusion of the work. The WebGis tool is perhaps one of the most suitable for the use of research work.
The desire to simplify the knowledge and use of the urban fabric is born with a didactic purpose and si the fundamental principle that led to the preparation of this project.

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