Mediterranean Architectural Heritage

RIPAM10

Edited by
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MRF

Mediterranean Architectural Heritage

RIPAM10

10th International Meeting on Mediterranean Architectural Heritage (RIPAM10), held from November 2-4, 2023, Er-Rachidia, Morocco

Editors

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Editorial

The International Meetings on Mediterranean Architectural Heritage (RIPAM) are significant scientific events that bring together a distinguished community of researchers, scholars, historians, architects, heritage scientists, experts, curators, and professionals from various countries and institutions around the Mediterranean basin, including Morocco, Italy, Portugal, France, Spain, Algeria, and Tunisia.

Since their inauguration in 2005, RIPAM has been held biennially, alternating between the two shores of the Mediterranean. In addition to this year's edition planned in Errachidia, Morocco has had the honor of hosting three editions respectively in Meknes, Marrakech, and Rabat in 2005, 2007, and 2019. Other editions of RIPAM have shone in Lisbon in 2009, M'Sila in 2012, Marseille in 2013, Tunisia in 2015, Genoa in 2017, and also in Lisbon in 2022. Each edition of RIPAM embodies a celebration of the Mediterranean architectural heritage, a forum for sharing knowledge, and an invaluable platform for international collaboration.

The Mediterranean region is distinguished by an architectural heritage of great richness and diversity, reflecting the ingenuity and creativity of artisans, as well as the cultural depth that characterizes this part of the globe. Recognizing that the building and construction sector is one of the largest emitters of greenhouse gases, accounting for about 39% of carbon emissions and 33% of waste production, stakeholders in this sector have been prompted to replace traditional materials with environmentally friendly materials.

Currently, concerns about energy and environmental issues in the construction industry have led sector stakeholders to prioritize the use of eco-materials instead of conventional materials. This trend has sparked renewed interest in construction using local materials in recent years (including earth, stone, wood, among others), due to their sustainability and highly favorable environmental footprint.

Similar to the oasis areas, the Drâa-Tafilalet region is home to an architectural heritage in earth of remarkable richness and diversity, encompassing structures such as ksars, kasbahs, mosques, fortifications, and granaries. The restoration of this heritage, beyond its immediate impact on the local community, holds substantial significance touching regional economy, cultural legacy, and the tourism sector. Rehabilitation projects frequently require the involvement of specialized local labor for construction, restoration, and rehabilitation work. Once restored, these structures become tourist attractions, generating economic benefits for local and regional businesses in the tourism, industrial, and agricultural sectors. They thus contribute to the preservation and enhancement of the architectural heritage in earth of invaluable richness specific to the region.

Thus, the city of Errachidia, capital of the region, becomes a conducive setting to host the tenth edition of the International Meeting on Mediterranean Architectural Heritage (RIPAM10) from November 2 to 4, 2023.

We are deeply thankful to the Minister of Culture, Youth, and Communication, as well as the President of Moulay Ismail University of Meknes. Their steadfast backing has played a pivotal role in the triumph of the RIPAM10 congress, nurturing global cooperation, streamlining the spread of research, and encouraging a vibrant exchange of ideas.

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Integrated Digital Survey Methodologies for Late Medieval Fortifications in Tuscany: The Fortress of Malmantile

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Keywords: Laser Scanner Survey, Malmantile, Walls, Arno Valley, Leonardo Drawing 8P

Abstract. The "castle of Malmantile", on the hills of Lastra a Signa, was built with the intention of strengthening the Florentine defenses against the rival city of Pisa. It represents one of the most interesting examples of late medieval fortification that has best preserved the entirety of the walls. It was originally built as a military outpost along the ancient road that connected Florence to Pisa. Following the downgrading of the military defense role, it became an inhabited center, a reference point for the surrounding fertile countryside. The data acquisition was carried out in three different survey campaigns, the first two carried out between 2009 and 2010 and the last, completed and updated, carried out in July 2018. The restitution work was carried out to give a complete representation of the place, its constructive characteristics and its state of conservation / decay. Exhaustive thematic maps have been extracted from the obtained documents, which have provided an adequate account of the conditions of the places.

Figure 1. Fortress of Malmantile, bird's eye view

Introduction

The fortress of Malmantile (figure1) rises on the hills that divide the Arno valley from the Pesa valley, in the municipality of Lastra a Signa. The fort represents one of the most interesting examples of late medieval fortification that has preserved the entirety of the original layout. It was originally built as a military outpost along the ancient road that connected Florence to Pisa, the

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Via Vecchia Pisana, and only later, when it lost its military functions, did it become a town. The survey work was carried out with three acquisition campaigns starting from 2009 and continued the following year and ended with a campaign to complete and integrate the data carried out in 2018. The first drawings addressed by individual portions followed the order of the acquisition campaigns and have been reordered, completed and normalized. The study of the territory and the morphology of the fortress has allowed the formulation of some fascinating hypotheses about the presence of the fortification in some representations of the fifteenth century.

Historical Analysis

The fortified nucleus of Malmantile is located on the medieval route of the Via Pisana (now Vecchia Pisana) in the stretch that goes from Lastra a Signa to Montelupo Fiorentino, on the ridge that divides the valleys of the Arno river and its tributary Pesa. The settlement stands on a hill, near the Romanesque church of San Pietro in Selva and documented as early as the thirteenth century [1], whose top has a slightly rounded morphology with a large area that can be defined as flat. The morphology of the site most likely facilitated the construction of a fortress where, as Gabriele Corsani writes in "Historical Atlas of Italian cities, Tuscany 1 Lastra a Signa" there was already a military stronghold since the 12th century [1]. With an almost regular rectangular plan (fig. 3), the Fortress was built to safeguard the Florentine area with respect to nearby Pisa; it is located along a ridge path already in existence in the Etruscan era, the ancient road to Pisa, which from the hills follows the route of the Arno along the Gonfolina gorges, up to the confluence with the Pesa stream. The route, in the stretch from Montelupo to Signa, is protected by numerous fortifications and culminates with the Castle of Signa, which was placed to defend the port and the only bridge over the Arno between Pisa and Florence [2]. The end of the 14th century was marked by numerous clashes and consequent looting, as in 1380 when the troops led by Alberico da Barbiano, who were carrying out looting in the Val d'Elsa area, clashed with the Florentines [3]; or as following the assault on the village of Lastra a Signa in 1397 by the troops of Galeazzo Visconti. These events made clear the inadequacy of the defenses set up to protect the "Lastrigiana Community". In this regard, the Florentine Republic believed that the time had come to ensure a safe refuge for the inhabitants of the territory and in particular of the districts of the village of Lastra a Signa and of the people of San Pietro in Selva [4]. On 14 April 1400 the construction of the fortress of Malmantile was approved at the same time as the construction of the walls of Lastra a Signa [1]. La Roccaforte, is located in a dominant position with respect to the Arno valley, and served, as well as for the refuge of the local populations against the raids of the opposing armies, as the main sighting site and stronghold able to organize the first defense with respect to any attacks that came from the coast. There is documentation on the progress of the construction works of the fortress up to 1413, when, with the provision for their financing for a further three years, news about it was interrupted. However, in 1424 the Florentine Republic, following the surveys of the ten supervisors who had found that the work had not completed the work as there were no towers, corbels and battlements, therefore arranged for the construction of the work to be finished [4].

It is said that Brunelleschi took part in the construction of the fortresses of Malmantile and nearby Lastra a Signa, however the analysis of historical data provides us with information that is not exactly corresponding. From the documents we know that on 12 September 1426, Filippo Brunelleschi and Biagio D'Antonio were commissioned by the Cathedral Workers to evaluate the work done "murorum portarum et anpiportarum castri slabs" to weld the workers [4]. So it seems that the intervention of the architect of the Dome of the Cathedral was limited to an "administrative test". However, between 1424 and 1426 we have no news about it, therefore we cannot exclude Brunelleschi's involvement in the construction of the walls of the two Isatrigian fortifications, even if these do not present innovative ideas, but are limited to implementing the knowledge hitherto adopted for military architecture [4].

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The cause of the loss of importance of the fortified axis, from Lastra a Signa to Malmantile, were: the slowness with which the works on the fortification of Malmantile were carried out; the type of construction adopted, however very similar to that used for the contemporary walls of Lastra a Signa, typical of late medieval buildings; a late completion of the work, which came when the rival city was also subdued, after the fall of the Florentine Republic in 1530 [1].

In the second half of the eighteenth century, the definitive reopening of the ancient roadway that ran along the Arno along the Gonfolina gorges caused the downgrading of the ridge route towards Pisa. Downgrading which, added to the loss of strategic-military importance of the fortified garrison of Malmantile, accentuated the isolation position of the fortification which from this moment on remains used as an agricultural village, within which there will not be a significant increase for a long time building and demographic [1].

Towards the end of the nineteenth century some houses began to be built both inside and outside the walls, although in 1896 Guido Carocci Regio Inspector of the Superintendence of Antiquities and Fine Arts of Florence, classified the walls of Malmantile, together with those of Lastra a Signa, as "buildings of local importance". [1]. However, the greatest manufacturing development will take place after World War II in the immediate vicinity of the Castle along the routes of the old Pisana road.

In 1969, in an attempt to stem a growing erosion of the territory around the walls with the D.M. of 10 January, the fortress and the surrounding area are subjected to landscape restrictions.

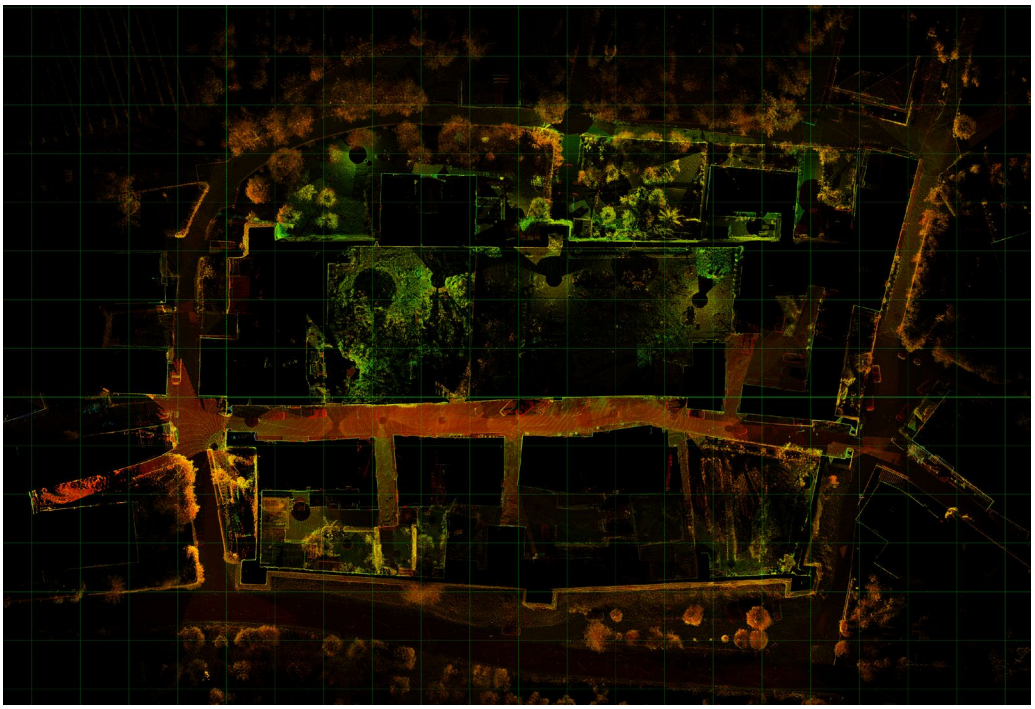

Figure 2. point of the laser Scanner survey, raster image of the projection in true size of the plamimetry of the Fortress of Malmantile

Typological Analysis

The late-Gothic fortress appears to be typologically in line with the fortifications of the fourteenth-century "Terre Nuove": it responds in fact to the military needs related to the defense of the markets that the Florentine Republic had felt the need to fortify. The defensive functionality was in line with the medieval tradition as regards the thickness of the walls, such as to be designed only to structurally support the elevation of the walls and not to resist the artillery shells that will make their entry into the military equipment only from the 16th century [4]. Malmantile Castle has a

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track of about 123x70 meters, describes an almost perfect rectangle and its perimeter is 373 meters (fig. 3). The fortress is arranged longitudinally along the axis of the road to Pisa in a direction from east to west. The six towers, without internal façade, all protrude on average about 3 meters from the perimeter of the walls, one for each of the four corners and one in the middle of each of the long sides. The two doors in the center of the short sides, also protruding from the walls, are connected by the only road in the fortification. On the sides of the road far from the walls are the buildings of the oldest construction, while the subsequent superfetations often leaned against the walls, both on the external and internal walls.

The perimeter of the walls of the castle of Malmantie is made of loose stones, however its state of conservation is not the best. Of the protruding defensive apparatus, built with corbels with stone brackets and pointed arches in bricks and machicolations with alternate arches for the plumbing defense, there is only a short section on the west front, on the north side of the Pisan gate (fig. 3).

Figure 3. Plan of the architectural survey of the Fortress of Malmantile

Survey Project

Born from the experiences of surveying and enhancing the territory of Lastra a Signa, realized thanks to the collaboration of the local municipal administration, the survey project of the fortress of Malmantile is consequent to the survey of the contemporary walls of Lastra a Signa [5].

The survey lasted for some years using multiple technologies, which harmonized in a product that could be defined as integrated digital survey [6].

Started with a first campaign in 2009 during which the external perimeter of the walls was analyzed, it continued in 2010 with the entire internal perimeter and the survey of the buildings. In 2018, a further campaign was carried out to detect all the points that for any reason had not been detected in previous campaigns. Finally, in 2021 a drone flight was carried out to create an accurate photogrammetry and acquire some bird's-eye images necessary for comparisons with Leonardo's Landscape drawing.

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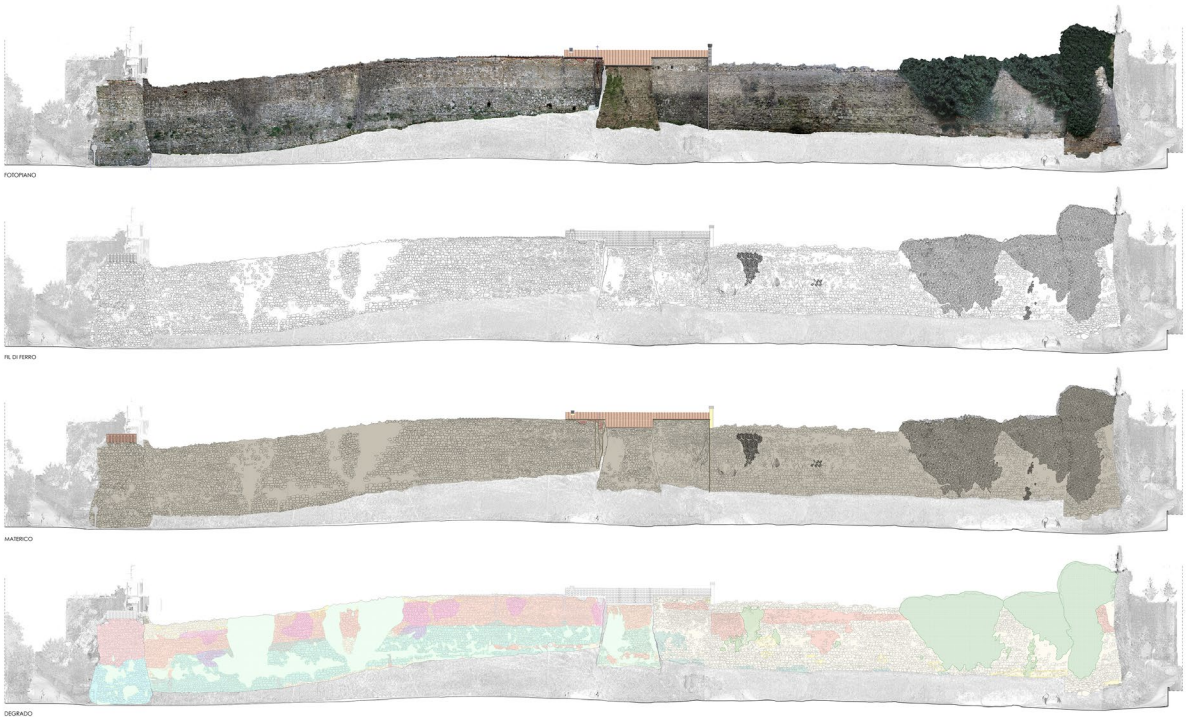

Figure 4. Front of the Nord Front (C-C' section) of the Fortress of Malmantile, from top to bottom, Photoplane, Wirfreme, Material Analysis and the state of conservation.

Many instruments were used in the laser scanner campaigns;

In 2009, during the survey of the external perimeter of the walls, an old instrument was used, the Leica HDS ScanStation1, a device that was also quite dated at the time, very slow but very precise, and able to create a reflectance data [7] very reliable. This type of instrumentation, due to its slowness and therefore to the modest working speed, made it possible to carry out no more than 15 scans a day which, to optimize times, had to be carried out with the least possible overlap. This condition, to allow the registration of the point cloud with sufficient reliability margins, made it necessary to create a topographic polygon.

The survey of the interior of the walls of 2010 was made with a more modern and faster instrument the Leica HDS6000 which allowed greater amounts of work and therefore a higher number of scans in the days we had available, in fact, it was possible do without the topographical survey, also considering the points of support obtained in the previous year's campaign (Fig. 2).

For the photogrammetric survey of the many fronts of the internal buildings and the walls of the fortress, 2D photo-straightening techniques were used [8], since the photomodeling and 3D photogrammetry software were still not very mature, therefore they were often incomplete and ineffective to use for such an extensive survey [9].

The representations, all made at a scale of 1:50, were performed with great accuracy by calibrating, first of all, the photographic images on the orthoimages (scaled rasterizations of the true-size projections of a certain section of the point cloud), thus creating a series of photoplanes perfectly coinciding with the data coming from the point cloud [10]. On the calibrated ortho-photoplanes, associated with the ortho-images, the sections and elevations were drawn with an accurate description of all the wall faces and all the details present on the fronts of the buildings and the fortress. The floor plans and the roof plan were drawn with the same technique[11].

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Figure 5. Front of the East Front (G-G' section) of the Fortress of Malmantile, from top to bottom, Photoplane, Wirfreme, Material Analysis and the state of conservation.

The survey shows the sections / elevation of the two fronts of the road inside the fortress, sections A-A 'and B-B'; all the external fronts of the fortress were also designed, sections C-C ', D-D', E-E ', and G-G '(Fig. 4, 5, 6,); finally an internal cross section, the H-H 'section (Fig. 7). Four thematic maps were made for each section: the ortho-photoplan which allowed to appreciate both the state of conservation of the materials but also the texture with which the wall faces were made; the wireframe drawing [12], in which the warping of the ashlars and the composition of the fronts with all the elements that contributed to its realization have been explained; in addition, the most evident materials and degradations were identified.

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Figure 6. Front of the West Front (D-D'' section) of the Fortress of Malmantile, from top to bottom, Photoplane, Wirfreme, Material Analysis and the state of conservation.

With the 2018 survey, made with a Z + F 5006 laser scanner, twin instrument of the Leica HDS6000, the survey was completed by making all those scans that had not been performed in the previous surveys. Above all, the scans along the external circuit of the fortress were carried out since the small number of scans made during the first campaign did not allow to acquire many gorges and shadow areas and details which, once detected, made it possible to obtain a complete geometric model of the Malmantile castle [13].

The scans from the three survey campaigns that lasted from 2009 to 2018 were registered with a new rigid roto-translation operation following the last survey. The resulting point cloud was subjected to certification and testing in relation to compliance with minimum error and data reliability requirements. This operation consists in carrying out several certain sections for each individual partial registration and numerous horizontal and vertical sections on the general registration. In these sections, the so-called section wires (which belong to different scans) are checked by checking that they have a coincident trend, and if this does not happen, the maximum distance is not greater than mm. 1.5 [7]. The certification of the point cloud allows to obtain elaborations made on certain data and therefore sufficiently reliable to perform subsequent elaborations and considerations.

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Figure 7. An internal cross section (H-H' section), of the Fortress of Malmantile, from top to bottom, Photoplane, Wirfreme, Material Analysis and the state of conservation.

The last phase of this survey was the flight made with a Jpi Mavic 2Pro drone in December 2021, it was necessary to take bird's eye images of the fortress of Malmantile (Fig. 8), useful images to verify some observations regarding the similarity between the fortification on the cobblestone hills and the walled city featured in Leonardo da Vinci's Landscape drawing. During this flight, the photogrammetric survey of the entire fortress and the surrounding context was also carried out using SfM acquisition techniques [14]. The images were assembled using 3D Zephir software with which a 3D model was made, from which a beautiful high definition aerial image was extracted (Fig. 9).

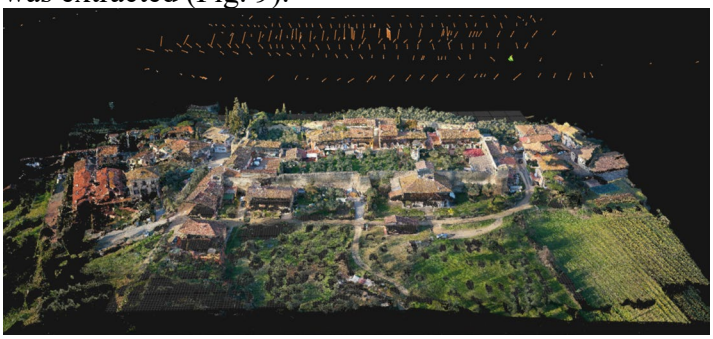

Figure 8. (above) Point cloud model of drone aerial photographs processed using SfM

Figure 9.(above right) Aerial view of Malmantile photo by drone and SfM techniques

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Final Remarks and Conclusions

In the first place:

The perimeter of the fortification of Malmantile describes an almost regular rectangle, which together with the arrangement of the towers, induces some observations and reflections. In the bird's eye view (c.1503-4 - Windsor, Royal Library, RCIN 912685) for the project of the large diversion canal of the Arno (Fig. 10), Leonardo makes a representation of the fortress of Malmantile, which, although concise, is perfectly recognizable in its salient elements: the rectangular layout with towers at the four corners and intermediate towers on the two long sides. By observing the Landscape drawing preserved in the Cabinet of Drawings and Prints of the Uffizi Gallery inventory 8P (Fig. 11), It is possible to see how the fortress represented on the left side of the landscape presents itself as a fortified village, with rectangular walls, towers at the corners and sectional towers on the long sides. So also in this drawing we can see some similarities with the fortress of Malmantile, as Roberta Barsanti also finds in her essay for the Leonardian celebrations for the 500th anniversary of the death of the genius Vinciano in 2019 [15]. These similarities do not allow us to think that the city represented in drawing 8P is Malmantile, since other characteristics, such as the keep on the right corner of the fortress or the density of houses inside, would make it impossible. However, we cannot fail to consider that Leonardo, in order to go from Florence to Vinci, had to pass through the Pisan road, therefore from Malmantile. It should be taken into consideration that drawing 8P was made in 1473 when Leonardo was 21 years old, and the castle on the Lastrigiane hills, precisely because it was on the route he took to go from Vinci to Florence, was certainly one of the places he had visited. That the small fortress had attracted Vinciano's interest can be deduced from the Royal Library map, as he had represented it despite the strategic context of the regional context, both for the changed geopolitical conditions and for the introduction of gunpowder , appeared to be less interesting in the panorama of the defenses of the Florentine Republic. Therefore, the layout of the Landscape drawing which refers to the regular layouts of the walls of the Terre Nuove, built in fourteenth-century Tuscany, which inspired the fortification of Malmantile (Fig. 14), built in the first half of the fifteenth century, may have attracted the young man's attention. Leonardo, so as to grasp some salient elements that he may have represented in the famous Landscape drawing.

Figure 10.. (above) Leonardo da Vinci, Detail of the bird's eye view drawing, 1503-4 , Windsor, Royal Library, RCIN 912685, for the project of the Arno's great diversion canal, the arrow indicates the fortress of Malmantile.

Figure 11. (above right) Leonardo da Vinci, Landscape drawing, Cabinet of Drawings and Prints of the Uffizi Gallery inventory 8P.

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Secondly:
It is common opinion that the fortress of Malmantile, over the centuries from its construction to today, has suffered some collapses and has lost a significant part of the defensive structures such as corbels, cantilevered walkways and battlements. This deduction is probably due to the presence of these garrisons in the contemporary walls of Lastra a Signa. Despite the poor state of conservation of the stone walls, where there are no adjacent buildings, the aforementioned cantilevered defenses are almost always present. The two fortifications were built in parallel to meet the same military needs, therefore it is quite likely to have interpreted the documents in which the conclusion of the work was requested, in particular the resolution of 1424 not only as evidence of the desire to prune the two fortifications but also how to have succeeded, which is certainly true for Lasta a Signa but probably not entirely true for Malmantile. From a careful reading made by Gioia Romagnoli of the resolution of 1424, it is clear that the ten supervisors appointed by the Florentine Republic to survey the state of the works of the castles of Lastra a Signa and Malmantile, report that the two fortifications lacked corbels and battlements, and there they arranged for their construction. However, in subsequent resolutions we no longer find reference to the Malmantile Castle and we do not find any trace of payments even in the final balance of Paolo di Matteo Fastelli Petriboni [4].

The careful study of the elevated wall faces allows us to observe how, the corbels present only on the west side of the walls, in the north portion with respect to the western door (Fig. 5), have their shutter around the altitude of about m. 8.60 with respect to the reference altitude 0.00 located at the southern corner of the Pisana gate, and reach the maximum altitude of m. 1120 (Fig. 12). The rest of the walls, except for the towers, does not exceed the altitude of m. 8.60 (Fig. 13). These observations, together with the payment documents not found, lead us to think that the corbels and battlements were not demolished by historical events and neglect, but that they were never built. As we have seen, the fortress is built at a time when military techniques and geopolitical assets change, the long continuation of the construction of the fortress of Malmantile, and the high costs incurred, at a certain point, probably, did not justify further expenses, reason why, it was probably decided to permanently interrupt the construction work.

Figure 12. (above) Malmantile, Porta Pisana with the stretch of walls where the corbels are still present and part of the walkway.

Figure 13. (above right) Detail of the defensive apparatus protruding, made with corbels with stone shelves and pointed arches in brick and embrasures with alternate arches for the defense leaping west front, near the Pisana door.

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Conclusions

This study has allowed us to advance two hypotheses, one certainly fascinating, which however is based exclusively on observations that may be plausible, but which do not have documents to confirm what has been stated, but above all remain exclusively in the field of possible but not demonstrable events.

In the second case, the study and observation of the elevated walls, which was cross-referenced with the research done by Gioia Romagnoli for "studies on the heritage of Lastra a Signa for his The Middle Ages in the hills south of Florence, provides us with a plausible explanation with respect to the story of the construction of the Malmantile Fortress.

Figure 14. The Fortress of Malmantile as seen from the hills to the south

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Keyword Index