Conservation Process of Porta Tiburtina, Rome: A Tool to Map, Protect, and Requalify the Gate

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Abstract. Porta Tiburtina is a historic gate within the Aurelian walls in Rome. It is connected to an ancient Augustan arch that carried three aqueducts. This arch served as an opening to an ancient street, Via Tiburtina, that connected Rome, and Tivoli. This paper describes the methodology used to understand this vast subject of the practice of Heritage Conservation in the context of the regular practice of architecture that has either been largely misunderstood or, at worse, regarded as architecture with an outdated twist. It focuses on a three-stage study process starting from the current state, followed by an elaborate historical data collection that leads to the declaration of the need for an intervention. Phase I talks about the awareness of the current context, both urban and structural, with architectural features that are key to acknowledging the threats and dangers to the monument. The next phase focuses on historical data collection and arrangement that helps understand the value lost on the monument and documents every change and transformation it has been through to make a more informed decision. The final stage is a proposed project plan that tends to be respectful, minimal, and in-context. It demonstrates the value of a methodology organized on an individually tested analysis to explore and confirm different aspects of the historic development of the monument. The main question it tries to answer is, how does an architect decide whether to conserve, preserve, restore, while retaining its material authenticity, and the memory and identity of the monument?

Keywords: Conservation · Historical data collection · Built heritage · Process · Identity · Minimal intervention · Porta Tiburtina · Aurelian Walls

1 Introduction to Porta Tiburtina

The research described here is part of the work undertaken for a master's degree in architecture conservation which explored the process of conservation of a monument in the city of Rome. Porta Tiburtina is a gate within the Aurelian walls that were built through 272AD (Under Emperor Aurelian) to 279AD during the reign of Probus. It encapsulates a preexisting monumental arch composed of travertine stone erected during the time of Augustus in 5BC constructed to permit the flow of water within the three aqueducts (Iulia, Tepula, and Marcia) superimposed over the arch [1–3]. The gate derives its name from the ancient path that passes via the arch, Via Tiburtina that connects

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Rome and Tivoli. Through the times, the gate changed many names based on either its ornamental or aesthetical features (Porta Taurina) or construction of an important church in the vicinity, basilica San Lorenzo (Porta San Lorenzo).

Rome is an ancient city, based on tangible and intangible cultural and built heritage. This includes the historic city center, the Aurelian walls, as well as the remains of the more ancient Servian walls. City gates currently constitute the extent of world heritage in Rome and yet, some unattended and under-maintained parts, monuments, and gates are constituted within these limits, Porta Tiburtina being one of them (Fig. 1).

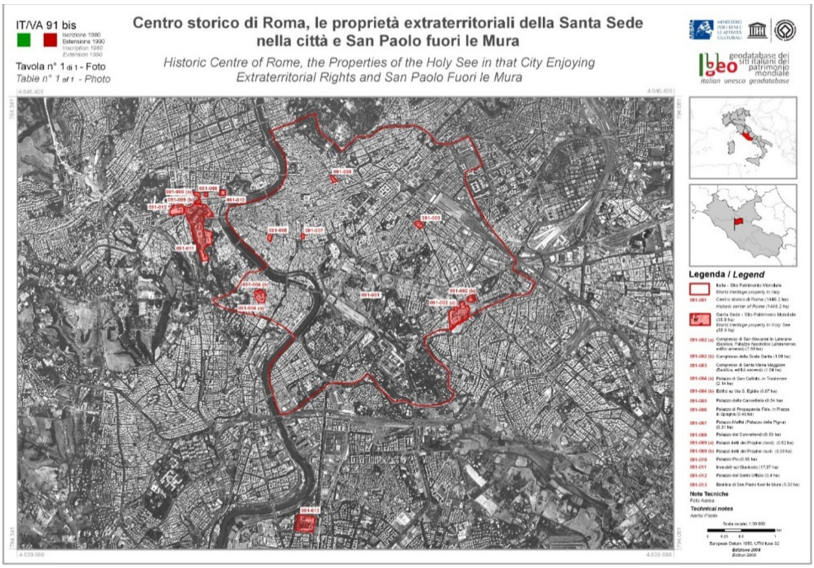


Fig. 1. Map showing the extent of world heritage city and the location of Porta Tiburtina (Source: WHC, UNESCO. IT/VA91 bis, 2015)

The map above shows the limits of the Historic Centre in the list of world heritage cities, while showing the monuments added in 1990, follows the line of the Aurelian wall. The property area of the Historic Centre of Rome (in Italy) was stated as 1446,2 ha. The property area of the Properties of the Holy See (in the Holy See) was stated as 38,9 ha. There is no buffer zone [4].

How do we start the process of understanding and protecting cultural heritage in such a complex context? The project is developed to understand in conflicts, its causes (structural or proximal), and repercussions on heritage. It is to divide them in typologies to understand vulnerability to instigate resilience. What can be linked to memories to be bought back and what needs to evolve into a new memory to create its own unique identity? While the project is a gate, in a city wall, it constitutes an original documentation of the past that can be preserved via architecture and conservation (Fig. 2).

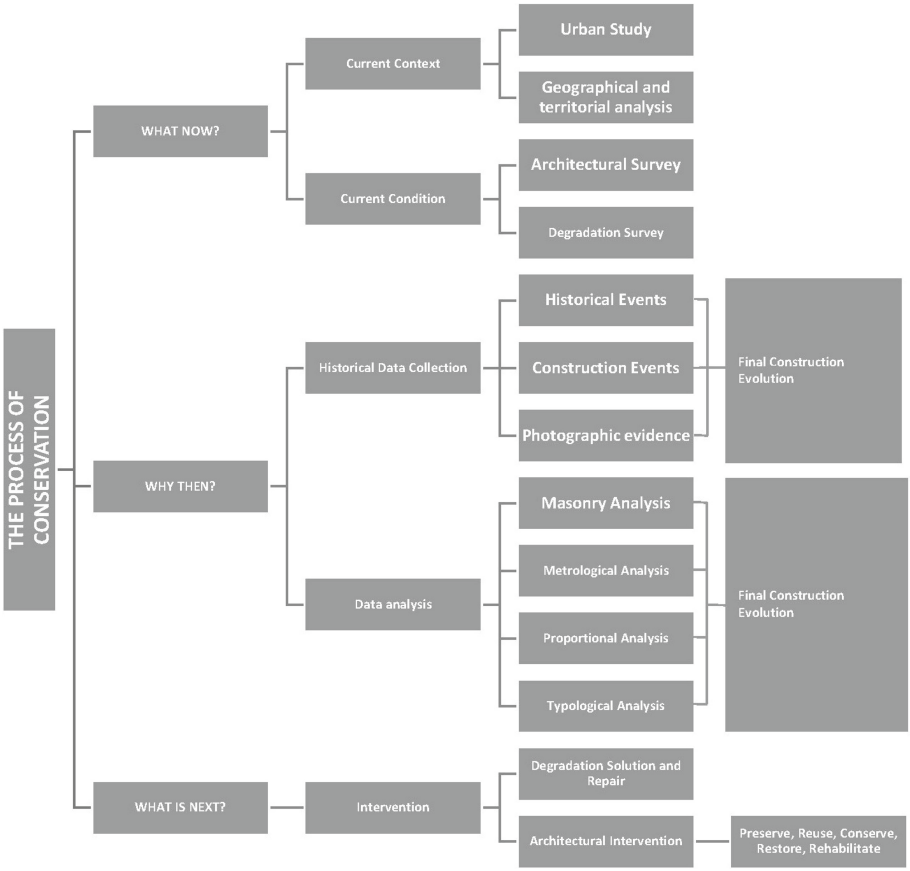


Fig. 2. Diagram of the process of conservation. (Source: Authors)

2 How to Architect? Beginning of a Process

2.1 Current Context - Geographical Analysis

The approach was developed to collect data that would help study the geographical and territorial context of the monument. Starting from a photographic collection of the site, and a recognition of other important landmarks in the area gives a wider perspective of area development and fabric growth. Urban and regional planning bodies and archives of cities are the usable sources to map the transformation of fabric, as for Rome, the PRG 2008 [5] is the most current development plan that underlines land use, zoning, and facilities around the chosen building.

The study of the evolution of the urban fabric was conducted using historical maps, found in historical archives, hand-drawn, or generated over the years. In this case, a comparison of the PRG with maps by Ludovico Muratori (1732), Giambattista Nolli (1748), Giuseppe Vasi (Late 1700's), Giovanni Battista Piranesi (Late 1700's), and Rodolfo Lanciani (1901) was used to understand the period of creation of streets, structures around, expansion of city limits connecting to the site [6, 7]. The availability of resources depends on every city's availability of archival collection and protection of documents. As in the case of Rome, most of this information is easily accessible online, documented, and in possession of several cultural institutions and universities.

2.2 State and Condition - Survey

For the survey and documentation, the collection of the data should be a combination of a total station or 3D scanner survey (direct survey), and photogrammetry (indirect survey). The direct survey is conducted to study the material consistency of the monument and to make reconstructions of the historical phases by a geometrical 2D method (Total Station) and a cloud point 3D method (Photogrammetry). Indirect survey (Photogrammetry) is required in case of inaccessibility and requirement of a detailed analysis of its geometry. The output of this survey enables the architect to measure in real time, precise dimensions of higher or inaccessible points and generate a 3D model comprising accurate architectural and geometrical information.

The 2D survey for geometrical drawings was done using total station Leica TPS700 to generate co-ordinates and points measuring angles to get accurate heights and points and make a precise elevation skeleton. As the city grew, the levels of roads increased giving a complex three levels of ground points to the monument. Two of these three points being inaccessible, were measured independently through a distometer (Using angle correction) and the triangulation method (using angles of two known points to mark the unknown point).

While with this method, the external lines were drawn precisely, the architectural survey demanded a more detailed output to study its features. This was comprehended using an indirect survey method, photogrammetry, a method that can be used with simple instruments such as camera, phone or a professional DSLR (Digital Single-Lens Reflex camera). For more accurate results, the use of a 3D laser scanner is possible, but at a higher expense. This process enables one to capture overlapping clear images to generate million-point clouds using the collineation process. Agisoft Metashape generates this cloud into a dense cloud and then processes the 3D based on location, geometry, and coordinates of these points to create a photographic clone of the monument with its features, degradation, and scaled measurements. This gives you two types of drawings for the next phase: geometrical drawings; technical, simple drawings of the general shape of the monument; and architectural drawings, detailed drawings of the current condition of the monument, and the elements within the site [8] (Figs. 3 and 4).

This process enabled us to identify discrepancies in construction, changes, and transformations of levels over time with the gate to the archeological area, identification of

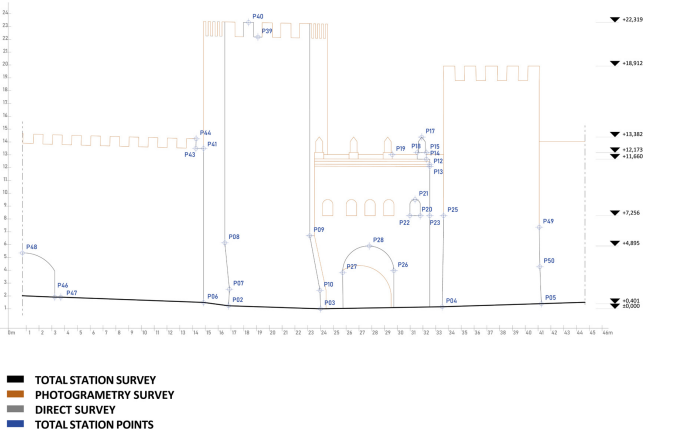


Fig. 3. Geometrical survey of the East Façade, showing different methods of the survey using color-coding. (Source: Authors)

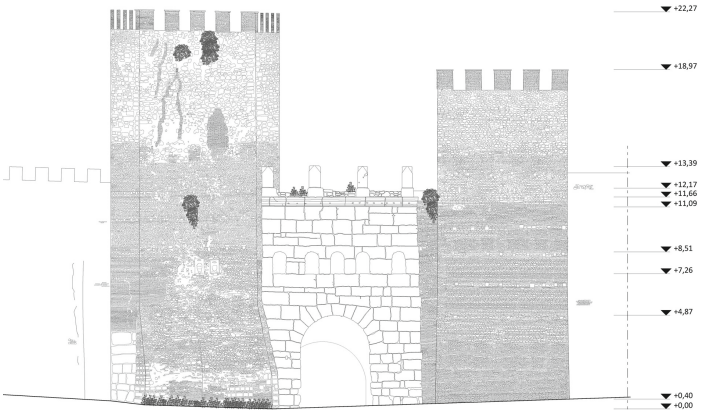


Fig. 4. Architectural survey of the East Façade because of a holistic survey. (Source: Authors)

degradation and structural failures, and lack of symmetry and proportions in some areas. It is important to quote that this survey is a representation of the reality of the monument, so if some parts are inaccessible, or not seen, should not be drawn, and represented. After the creation of the complete drawings is time to start the first phase of analysis (Fig. 5).

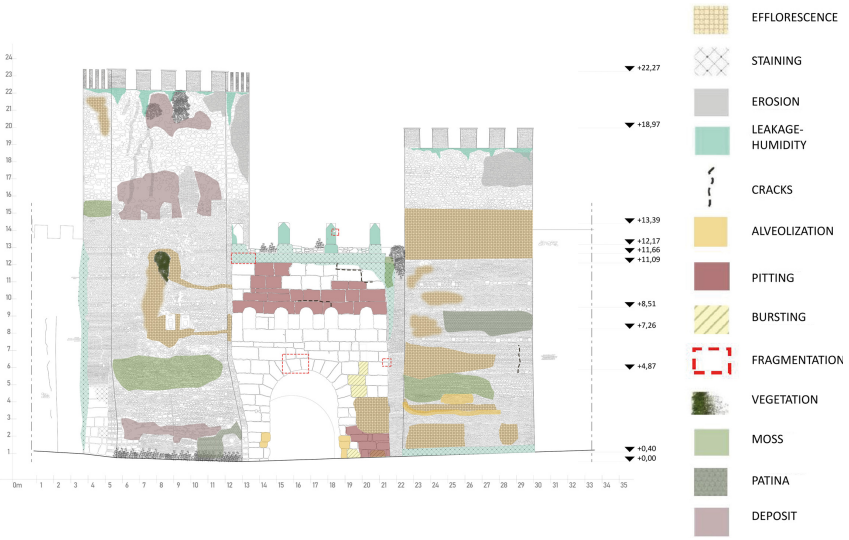


Fig. 5. Degradation mapping east façade. (Source: Authors)

The photographic catalog achieved from documentation will be the guide to proceed with the degradation analysis. It is necessary to map and identify every type of failure and disintegration on the monument to detail zones and areas that need intervention and fully understand the being of the monument. An important document guide for understanding damage is the *Illustrated Glossary on Stone Deterioration* published by ICOMOS, where each of these phenomena is explained in detail with images, descriptions, and causes to help identify them on one's project [9]. This analysis is usually based on visual observation, unless a heavy failure is observed, and non-destructive testing are involved for a deeper and accurate analysis.

3 Where Does It All Come from? Summary of Historical Data Collection Process

3.1 Historic Survey

To make historical and cultural decisions:

Once we have the current state of a building, we can proceed to the analysis phase which includes extensive historic data collection. This answers to, what are the main events connected to the monument? How did the construction process start? What are the stages of transformation and layering? At what point did the monument lose its identity? These are some of the questions we need to solve to generate a cohesive timeline.

The historical sources can be divided into two groups: primary sources, the direct witnesses of an event; and secondary sources, which is the work based on the primary sources. On the other hand, another way of classifying the sources is:

- Verbal sources: these sources can be written or oral, and are all the chronicles, biographies, annals, epigraphs, coins, etc.
- Non-verbal sources: this category includes all the monuments, landscapes, iconography, and everyday items.

The best way to research history in Rome is to explore the archives, libraries, and databases. For the Antique monuments, there are different Databases. One of them is called Census.de [10], which documents the main events from each renaissance monument with multiple written references. For the Aurelian Walls, in general, and on Porta Tiburtina, in particular, important information can be taken from archaeological and architectural studies on the monument [11–15] (Fig. 6).

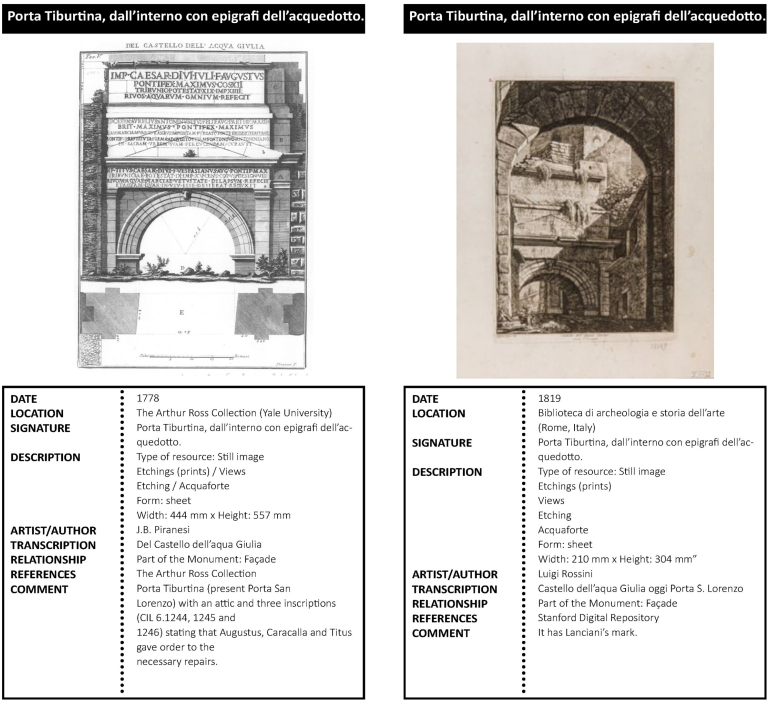


Fig. 6. Examples of document data sheets. (Source: Authors)

One of the important tools used to organize the information is by generating datasheets [16]. This format organizes images, photographs, and drawings, according to their date of creation. Through this method, we compare the physical changes, or the existing ornaments interpreted by the artist in the period of creation, we can also understand the social interaction of the community with the monument in that period. Datasheets can be divided based on evidence, documents, events, and iconography. Each of these sheets evaluates and reference the events to reach a final timeline that helps understand the monument (Fig. 7).

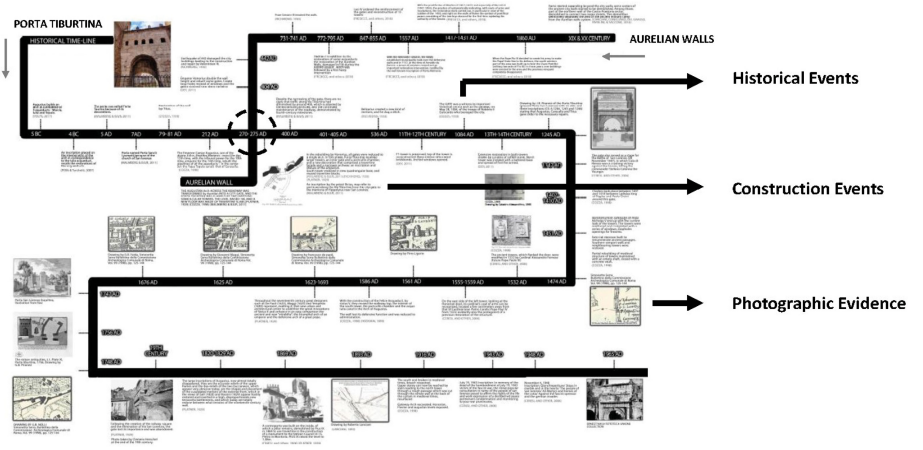


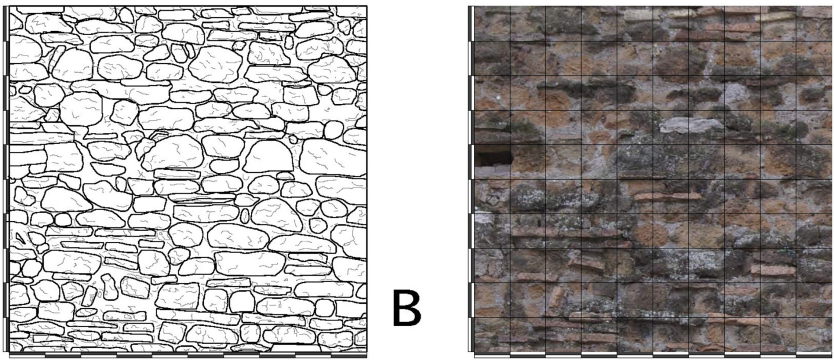
Fig. 7. Final timeline. (Source: Authors)

3.2 Reconstruct Its Beginning to Understand What Leads to Today

To make structural and technical decisions:

For this project, before we made a structural or technical decision, we divided the analysis into four main parts. The following type of analysis evaluates different structural components into materials, studying its age and process of degradation as well as determines a proportional precision of the monument concerning the current units.

Masonry Analysis. For this analysis, we identified all the types of masonry presented in the monument and we created individual tables, where, with the appropriate bibliography, we recognized the main characteristics of them. This process leads to further analysis of mortar and stone for dating and shows the layering on a monument; supports the process of differencing the original materials and the repairs performed through the years. This process helped us understand the different periods of construction according to the materials and construction techniques. Masonry analysis is mainly important in ancient monuments with layers of intervention and transformation, constructed in bricks or stones. This analysis was carried out using a tabular format that serves as a data sheet documenting information on the typology, stratigraphy, origin, and period of that masonry. Porta Tiburtina identified with 7 types of masonry, added along with its transformation and repair. This ranged from original remains from 272AD to the most recent intervention in the early 1900s. This process further clears the need for material testing for original masonry to study its degradation and identify solutions to major decay based on their material specification, mortar granulometry. In the future, this way of documentation can help in sample testing and dating. To identify the dating of certain masonry, some important sources are brick stamps and emblems. By the early 2nd century CE, brick stamps included the name of the consuls for the year of production, thereby making it easier for archaeologists to date a specific construction [17]. This analysis was carried out with reference-based on archival sources, iconography, and historic evidence found before, as well as further analysis of typologically similar monuments (Fig. 8).



Sample Classification B			Date 1447-1455			
Static function Elevation (East Facade)		State of conservation Bad		Stratigraphic relationship Both towers adjacent to Porta tiburtina		
MATERIALS						
STONE	origin Reused	Type Tufa	Colour Ochre	Shape Random Rubble	Dimensions Width: 6-30cm Height: 6-18cm	
BRICKS	Reused	Tile	Rust orange	Rectangular	Width: 12-50cm Height: 3-5cm	
MORTARS	Colour Grey	Binder Lime	Granulometry Medium sand 0.2-0.63mm	Aggregate Pozzolana	Consistency Friable	Joint 0.2-3cm
Masonry disposition Insertion of tiles and bricks between stones with irregular texture						
Remarks Mainly spotted in the lower part in the towers adjecent to Porta Tiburtina						

Fig. 8. The format of the table was created to recognize the types of masonry. (Source: Authors)

Proportional Analysis. This analysis describes the relationship between the structural and ornamental elements in the monument, also to see if there is symmetry in their geometric shape. It deals with the placement of openings with the ratio to build walls and structural elements. This analysis helps piece back broken elements that might have been squandered and understand the ratio and proportions of construction.

Metrological Analysis. An important analysis while studying an ancient monument, metrological analysis proves to be one of the most important steps to reconstruct the history of a monument. Due to its original time of construction, the units used to measure and build, are different and varied to the ones we use today. Italy observed a wave of many units such as the Roman foot (29.48 cm), used by the Romans, the Lombard foot (28.75 cm), used before the Italian conquest, up to 1861, the Carolingian foot (34 cm) found from the 8th to 9th century, Byzantine foot, etc. [18, 19] This analysis is conducted by a trial and error process where each of these measurements suspected to be used in the period of construction, is perceived as a proportional circle of the current unit (m) and superimposed over the geometrical drawing for an accurate conclusion. This process

helps understand the process of construction, discrepancies to find the best solution in case of reconstruction to be factually and historically accurate (Fig. 9).

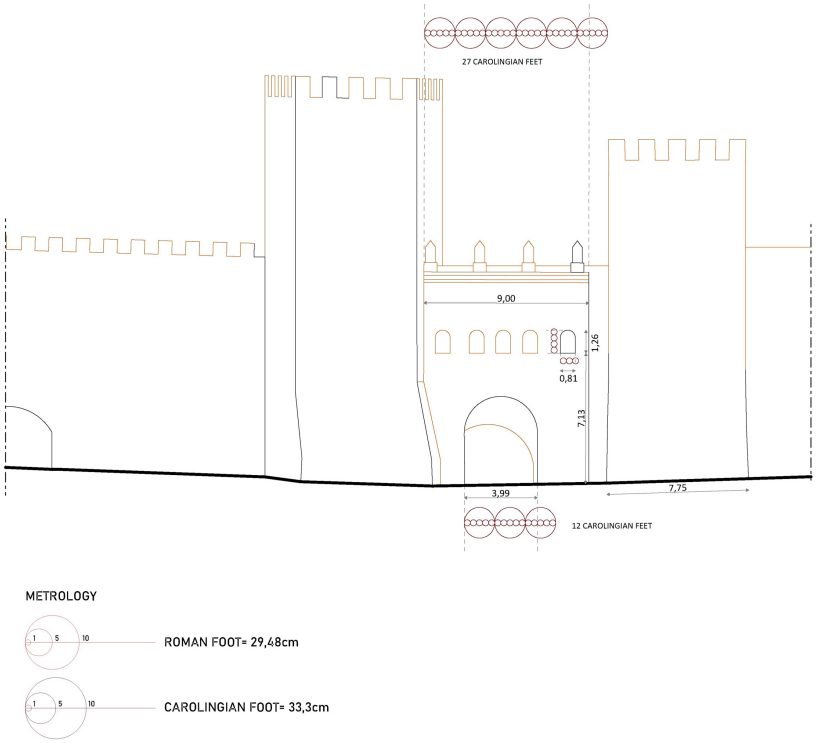


Fig. 9. Metrological analysis of the East Façade. (Source: Authors)

Typological Analysis. It is the study of similar structures and with uses meant to serve a similar purpose. This study works like a case study to compare aesthetical, structural, and architectural elements. In terms of conservation, this process also helped understand gates built in Roman times within city walls across Europe [20]. A few of these comparisons include Le Mans walls, France, Segusium (Susa), Torino, etc. Gates for comparison were chosen based on their physical characteristics such as the shape of the gate, presence of courtyard (controporte), presence of defense chambers, and merlons. The study produced results based on dimensional quality, material difference, and current condition/use. This helped conclude the analysis phase by filling gaps of missing information within the monument. Porta Tiburtina was best compared to other gates built in the Aurelian walls, Porta Flaminia, Porta Salaria (demolished in 1921), Porta Asinaria, Porta Ostiense, all built during the 3rd century (Fig. 10).

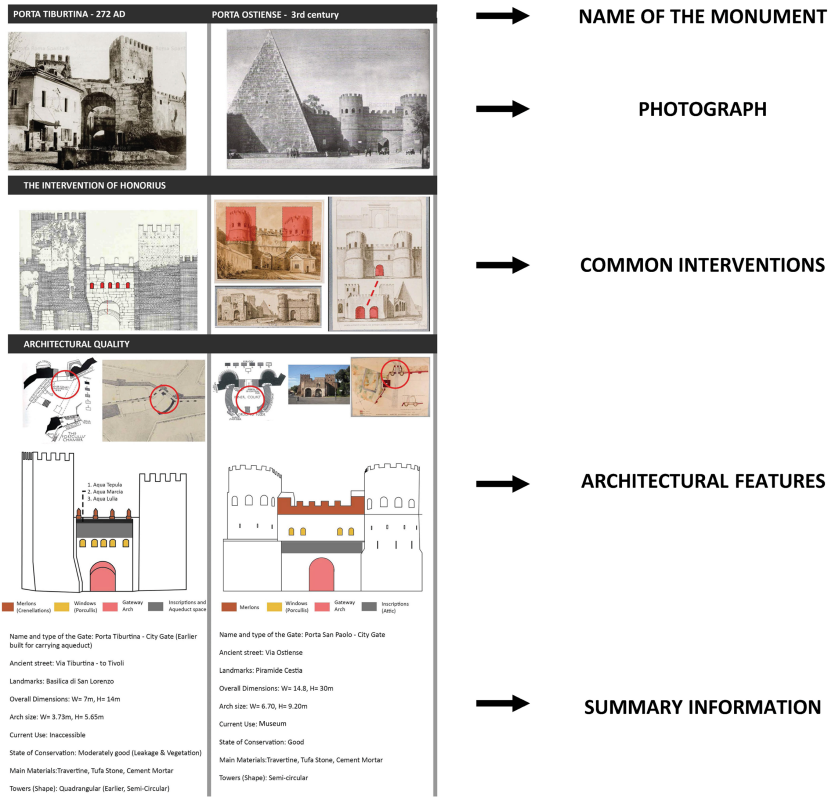


Fig. 10. Example of a typological analysis. (Source: Authors)

4 What Do We Do Now? How Do We Reach an Intervention?

4.1 The Idea of Opening the Monument to the People

Ancient monuments ought to have a minimal intervention. By this stage, an architect has enough data analysis, sources, and evidence to make a well-informed decision of the type of intervention required by the monument. The main intervention is repairs and cleaning processes based on degradation mapping achieved through the initial survey. A basic intervention was developed to re-open Porta Tiburtina to the public, to use the gate as a passage. The concept is based primarily on the idea of highlighting the archaeological area by creating a platform, going over the archaeological site, and crossing the gate. Decisions made for chemicals and mechanical processes for cleaning and repairs were based on material analysis and the most suitable and least harmful materials viable for the same. Degradation solutions were planned in stages of pre-consolidation, protecting the monument, basic cleaning, and then coating or structural repairs.

Goal. Accessibility

- To reconnect the traces of the ancient road, Via Tiburtina

- To make use to the gate as a transition as well as a cultural point
- To leave the current heritage and archeological site undisturbed.

Principles. Based on international heritage charters for good practice of conservation such as the Venice charter and NARA charter [21–23].

- Minimal construction: The intervention is devised in a way that requires minimal construction leading to low disruption to the site and maintaining the respect of its existence.
- Reversibility: The intervention material is easily reversible as well as can be dismantled without causing damage.
- Minimal intrusion: This intervention will not intrude with the current function but enhance its use and capability to a respectable cultural point of view.
- Contextual conservation: The choice of intervention fits the context of the monument and neighborhood.

Conservation is a movement-activated by the realization that the natural and cultural resources of this planet are limited and are being eroded at an alarming rate. Architecture is an irreplaceable cultural resource. For heritage, Reuse is not an alternative, is a tool that we use to prevent new damages due to the abandonment or disintegration. The architectural conservation aims to prolong the life of buildings and the built environment of historic cities so that future generations can enjoy them profitably [24]. This follows the premise that the future of the past is as, if not more, important than the past itself. As Giovanni Carbonara states, "The project is, in fact, the creative synthesis of the various needs, where what is done to remove barriers takes becomes a normal providence destined to ensure, to all, the best use of the heritage" [25].

References

1. Ashby, T.: The Aqueducts of Ancient Rome. The Clarendon Press, Oxford (1935)
2. Volpe, R.: Mura e Acquedotti: coincidenze e persistenze. In: Edizioni Roma. TRE-Press, pp. 103–113, Rome, Italy (2017)
3. Hodgkin, T.: The Walls, Gates, and Aqueducts of Rome. John Murray, London (1899)
4. World Heritage Convention, UNESCO. https://whc.unesco.org/en/list/91/documents/.
5. Roma Capitale Urbanistica, Piano Regolatore Generale 2008 (2008). https://www.urbanistica.comune.roma.it/prg.html
6. Muratori, S., et al.: Studi per un'operante storia di Roma, C.N.R., Roma (1963)
7. Zampilli, M.: Roma. Fasi formative tessuti e tipi edilizi della città storica. https://www.google.com/search?q=Michele+Zampilli%2C+%E2%80%9CRoma%2C+Fasi+Formative+Tessuti+e+Tipi+Edilizi+della+Citta%2C%E2%80%9D&oq=Michele+Zampilli%2C+%E2%80%9CRoma%2C+Fasi+Formative+Tessuti+e+Tipi+Edilizi+della+Citta%2C%E2%80%9D&aqs=chrome..69i57.484j0j8&sourceid=chrome&ie=UTF-8
8. Canciani, M., Conigliaro, E., Del Grasso, M., Papalini, P.,Saccone, M. 3D Survey and Augmented Reality for Cultural Heritage. The Case Study of Aurelian Wall at Sastra Praetoria in Rome. International Society of Photogrammetry and Remote Sensing (2016). https://www.int-arch-photogramm-remote-sens-spatial-inf-sci.net/XLI-B5/931/2016/

9. ICOMOS.: Illustrated glossary on stone deterioration patterns. In: Monuments and Sites XV. Ateliers 30 Impression, Champigny/Marne, France (2008)
10. Census of Antique Works of Art and Architecture Known in the Renaissance, developed by Humboldt-Universität zu Berlin Institut für Kunst- und Bildgeschichte / Census. https://www.census.de/
11. Richmond, I.A.: The City Walls of Imperial Rome. An account of its Architectural Development from Aurelian to Narses. The Clarendon Press, Oxford (1930)
12. Cozza, L.: Osservazioni sulle mura aureliane a Roma. Analecta Romana Instituti Danici **16**, 25–138 (1987)
13. Cozza, L.: Mura di Roma dalla Porta Nomentana alla Tiburina. Analecta Romana Instituti Danici **25**, 7–113 (1998)
14. Mancini, R.: Le mura aureliane di Roma. Atlante di un palinsesto murario. Edizioni Quasar, Rome (2001)
15. Dey, H.W.: The Aurelian Wall and the Refashioning of Imperial Rome AD 271–855. Cambridge University Press, Cambridge (2011)
16. Lanciani, R.: Stralcio della zona di Porta Tiburtina 1893–94. FORMA URBIS ROMAE, Rome (1893)
17. Pfeiffer, G.J., Van Buren, A., Armstrong, H.: Stamps on Bricks and Tiles from the Aurelian Wall at Rome. Supplementary Papers of the American School of Classical Studies in Rome, pp. 1–86 (1905)
18. Martini, A.: Manuale di metrologia, ossia misure, pesi e monete in uso attualmente e anticamente presso tutti i popoli. Loesher, Torino (1883)
19. Salvatori, M.: Manuale di Metrologia per architetti studiosi di storia dell'architettura ed archeologi. Liguori, Napoli (2006)
20. Intagliata, E., Barker, S.J., Courault, C. (eds.): City Walls in Late Antiquity: An Empire-wide Perspective. Oxbow Books, Oxford (2020)
21. Jokilehto, J.: Preservation theory unfolding. Future Anterior J. Hist. Preserv. Hist. Theory Criticism **3**(1), 1–9 (2006)
22. The Nara Document on Authenticity (1994). https://www.international.icomos.org/charters/nara-e.pdf
23. The 2nd International Congress of Architects and Technicians of Historic Monuments, Venice, 1964. ICOMOS INTERNATIONAL (1964). https://www.international.icomos.org/charters/venice_e.pdf
24. Malmberg, S., Bjur, H.: Movement and Urban Development at Two city Gates in Rome: The Porta Esquilina and Porta Tiburtina. En Laurence, R., Newsome, D., Rome, Ostia, Pompeii: Movement and Space, pp. 361–385. Oxford University Press, Oxford (2011)
25. Carbonara, G. Restauro Architettonico: principi e metodo. In: Mancosu Editore. Rome, Italy (2013)