The Theatre of Marcellus: between historical memory and digital innovation

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Abstract – This study presents an integrated research initiative on the Theatre of Marcellus, combining archaeological, architectural, and digital methodologies. The project investigates the site's historical evolution and sociopolitical significance within the Campo Marzio through a multidisciplinary approach. A detailed 3D laser scanning and photogrammetric survey supported documentation and modeling efforts, enabling critical interpretation and digital reconstruction. The study emphasizes modeling strategies for restoration analysis, lighting simulations, and heritage communication. The resulting 3D repository serves both scientific and public engagement purposes, offering a dynamic platform for interpretation and preservation of one of Rome's most iconic architectural and urban landmarks.

I. INTRODUCTION

The proposal aims at developing an integrated activity through the direct involvement of specialists in all the research areas connected to the s.c. Archaeological Architecture (AA) (survey, modeling, history, archaeology, restoration, communication). The chosen case study is the Theater of Marcello in the southern Campo Marzio, also called Circus Flaminius, a very important archaeological area of Rome, with the main monuments contained such as *Porticus Octaviae* and Temple of Apollo Sosiano, as part of one of the most impressive roman architectonic complex. In a wider chronological and archaeological context, it is probable that, even before its construction in the *Prata Flaminia* - an extra-pomerial area in which foreign cults and ritualistic horse races are attested - a cult area already existed that was dedicated to the god Apollo. Since the *Età Regia and repubblicana*, the area was consecrated to the god Mars and used for military exercises. The southernmost part, starting from the slopes of the Campidoglio (where the remains of the Theater of Marcellus and the portico of Octavia are currently visible) was distinct from the actual *Campus Martius*, with the toponym of Circo Flaminio, the area was crossed by the Via Flaminia. The beginning of the monumentalization of the area occurred with the theater of Pompey in 55 BC. Under Caesar, the buildings linked to the elections were arranged, the *Saepta Iulia* (completed by Augustus) and the *Villa publica*. In *Età regia* and *alto-repubblicana*, there are four temples built in the area from the mid-6th century BC. to 324 BC: including the temple of Apollo Sosiano (431 BC). In 179 BC the temple may well have been reconstructed by M. Fulvius Nobilior. In the same year, the censor M. Aemilius Lepidus issued a contract for the construction of a theatre and proscenium *ad aedem Apollinis*. It is known that the works on the new theatre led to a reorganization of the area between the *Circus Flaminius* and the *Foro Olitorio*, whit the demolition of some temples like the temples of Diana and Apollo, and at least partially, the *Circus Flaminius*. The construction of the theatre (which, from its conception under Caesar to its dedication under Augustus, accompanied the entire reconstruction of the Temple of Apollo) has already been attributed to the elimination of the temple's republican staircase during its radical remodeling. In 13 BC the building was inaugurated and dedicated to Marcus Claudius Marcellus, nephew of Augustus, son of Ottavia. In this paper we present the first results of this research, through key points that can be summarized as follows: Interdisciplinary collaboration understood as the involvement of architects, archaeologists, historians, restorers and engineers guarantees a holistic approach. Their combined experience allows for a comprehensive understanding of the complex phenomena related to AA. Scientific Investigation, that involves analyzing both material and immaterial properties. Documentation and research perspectives play a crucial role in uncovering the secrets of these ancient structures. Cognitive Framework, by collaborating, specialists contribute to constructing a cognitive framework that facilitates critical analyses of artifacts, enabling a deeper appreciation of their historical and cultural significance. Digital Environment, leveraging methodologies in the digital environment enhances data exchange and sharing. Specialists benefit from innovative tools for managing heterogeneous data. This type of integrated methodology allows the construction of a workflow capable of relating different disciplines. Starting from this, the project aims to implement and manage a 3D

repository, containing different types of data, useful for investigation and communication purposes, using innovative acquisition procedures and new interactive tools, the repository will serve as a dynamic platform for ongoing research, education, and public engagement. One of the experiments carried out on the product of this research was the construction of a digital model, deriving from acquisitions with 3d laser scanner and photogrammetry, very light and easily navigable on which lighting experiments were carried out, through the use of Relux Informatik software, as part of a lighting project for some of the most important monuments in Rome.

The topic proposed in this paper is part of a series of research projects and studies that our research group has been pursuing for several years. The southern Campus Martius has been included in a University Research Project, funded by Sapienza University of Rome, for 2024, entitled: *Complex and integrated survey methodologies: Documentation, Modeling, and Communication of the southern Campus Martius (Circus Flaminius, Porticus Octaviae, Temple of Apollo Sosiano, Theater of Marcellus, Fabricius Bridge) in Rome.*

This same area has also been studied as part of the Science of Representation 3 course, taught by Professor Carlo Inglese, Faculty of Architecture, Sapienza University of Rome. The SDR3 Course produced a series of two-dimensional and three-dimensional works that integrate the model archive, providing a scientifically reliable basis for the studies undertaken in the research.

C.I.

II. The Historical and Social Role of the Architecture of the Theatre of Marcellus

The Theatre of Marcellus, one of the most significant monuments of ancient Roman architecture, stands as an emblematic case for understanding the historical and social role of theatrical buildings in Republican and Imperial Rome. Julius Caesar initiated its construction to rival the Theatre of Pompey. The theatre was first used in 17 BCE during the *Ludi Saeculares* and later dedicated to Augustus' nephew and adopted son, Marcus Claudius Marcellus, who had died prematurely in 23 BCE. Built in a strategic area of the Campus Martius, between the Tiber River and the Temple of Apollo Sosianus, it reflects Augustus' political and symbolic will to consolidate power through monumental urbanism and the control of public space [1].

From an architectural perspective, the Theatre of Marcellus represents a turning point: for the first time in Rome's urban history, a fully integrated structure was built, in which *cavea* and stage form a unified and permanent organism, no longer dependent on ephemeral wooden scaffolding. This configuration expresses a clear political and urbanistic intention of the Augustan era: the theatre becomes part of a stable monumentalization project of the urban space, aiming to control gathering places and regulate the forms of public life.

The building also fulfilled highly sophisticated functional needs. The cavea was divided into ima, media, and summa, reserved respectively for senators, equites, and the general populace. Each group accessed the theatre through dedicated and independent paths, in accordance with the Lex Julia theatralis [2]. Senators entered directly from the parodoi and reached the ima cavea with ease. The equites used a ramp leading to the middle ambulatory, known as the "Ambulacrum of the Knights," while the populace climbed longer ramps to the summa cavea. This distributive principle — which separated access routes by social class — later served as a model for the Flavian Amphitheatre, where circulation flows were organized within a more permeable structure [3], [4], [5].

The lower ambulatory, covered by a continuous barrel vault, functioned as the main distribution space; on the upper floor, however, the barrel vaults were arranged perpendicular to the façade wall, forming a trapezoidal plan; this technical choice met structural needs, aiming to contain lateral thrusts and prevent façade collapse.

The external appearance of the theatre was equally innovative. Its semicircular façade was articulated by superimposed arcades framed by half-columns. At ground level, the order was Doric (lacking fluting and a base, in an "Augustan" variant); the first level used Attic Ionic; and the third level likely carried a Corinthian order, possibly applied to a solid or windowed wall [6]. This scheme, known as the *Theatermotiv*, finds its first fully preserved example here and became a reference point for later architecture employing theories of superimposed orders. Particularly striking were the keystones, decorated with colossal marble masks representing the three classical Greek theatrical genres — tragedy, comedy, and satyr drama. These masks consecrated, on an urban scale, the public's passion for Roman theatrical culture [7].

These are among the earliest known examples of such decoration, combining aesthetic value with symbolic meaning. The masks were made of marble (predominantly from Luna), carved using toothed chisels and drills; they were then fixed with metal clamps to the keystones of the arches, so as to be clearly visible even from a distance due to their forward inclination.

The theatre, capable of holding between 13,000 and 15,000 spectators, was not only a center for dramatic performances, but a true place of civic cohesion. The shows, often offered as acts of *evergetism*, fostered civic cohesion and reinforced elite-public relationships. At the same time, the building also fulfilled an identity and toponymic function, as numerous imperial-period inscriptions remain that indicate locations "*ad theatrum*

Marcelli"[1].

In the following centuries, the theatre underwent a long history of transformations and reuse. In the Early Middle Ages, the arches were buried by floods from the Tiber and used for artisanal and commercial activities. The cavea was filled in and hosted residential structures, transforming the theatre into a sort of artificial hill, known in documents as *mons Fabiorum* or *mons Savelli*, depending on the families who owned it [8]. In the sixteenth century, Baldassarre Peruzzi built the Palazzo Savelli on top of it, adapting the Roman structure into an aristocratic residence.

The Theatre of Marcellus is a unique architectural and historical case in the Roman panorama: it is at once an urban monument, a civic space, a propagandistic vehicle, and an object of continuous reuse and transformation. Its architecture reflects the technical and symbolic evolution of the Augustan age, in which urban planning became a tool of power and social mediation. Its long physical and semantic survival demonstrates how theatrical architecture can transcend the boundaries of ephemeral spectacle to leave a lasting mark on the history of cities and communities. Today, the Theatre of Marcellus remains an identity-forming node in the city of Rome, not only as a testimony of the imperial past, but as a living palimpsest of the historical and social stratification of the *Urbs*.

<div align="right">S.L.</div>

III. DOCUMENTATION THROUGH 3D SURVEY

In the context of a project focused on the study and three-dimensional documentation of the site, a laser scanning survey was carried out with the goal of producing an accurate and comprehensive representation of both the external structures and internal spaces.

To achieve this objective, two different instruments were selected based on the specific morphological and dimensional characteristics of the areas to be surveyed: the Leica ScanStation C10 was used for documenting the exterior, while the Faro Focus M70 was employed for the interior galleries.

The external structures of the Theatre of Marcellus—particularly the façade with its superimposed arches—were surveyed using the Leica C10, a high-performance long-range scanner capable of acquiring millions of points with millimetric precision. Specifically designed for large-scale topographic surveys, this instrument proved ideal for documenting the monument in its true dimensions, accurately capturing the complex geometry and the irregular surfaces of travertine, a characteristic material of Roman construction.

The survey was organized into multiple scanning stations distributed along the entire perimeter of the theatre, with particular attention paid to the overlap between individual scans to facilitate alignment.

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[1] *CIL*, I², p. 217, 240, 245, 252, 339.

The second area of investigation focused on the galleries and vaults, for which the Faro Focus M70 was used, a compact, short- to medium-range scanner that is easy to transport. This choice was driven by the need to operate in confined and sometimes poorly lit environments (fig. 1).
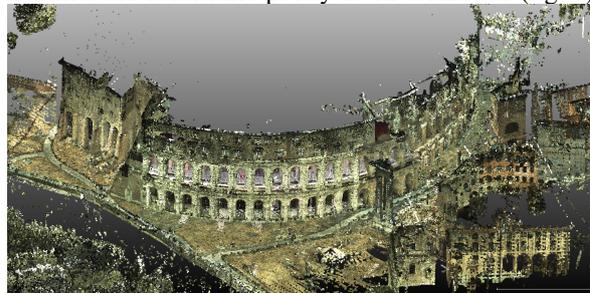

Fig. 1. 3D Laser scanner point cloud.

The Faro enabled fast and detailed scans, producing a high-density point cloud that highlighted the structural configuration of the vaulted spaces. As with the exterior, the scanning process was divided into several stations, with a methodology that ensured continuity between exterior and interior data—crucial for overall alignment.

Once data acquisition was completed, point cloud registration was performed using software such as ReCap. The result was a complete and coherent three-dimensional model that not only allows for extremely accurate metric analysis but also serves as a basis for a historical and stratigraphic reading of the structure—valuable for future restoration work, structural deformation monitoring, or decay assessment.

The point cloud generated by the laser scanning survey constitutes the foundational dataset for various operational and research applications (fig. 2).

Fig. 2. Point cloud view in elevation of the Theatre of Marcellus.

First and foremost, it was used to create accurate two-dimensional technical drawings: plans, sections, elevations, and architectural details, essential for the constructive and structural analysis of the monument.

These drawings were extracted via orthogonal sections from the point cloud and processed in CAD environments, maintaining high metric consistency.

At the same time, the point cloud enabled the three-dimensional modeling of the theatre using solid and mesh modeling software, aiming to create a digital model that faithfully reflects reality. This 3D model serves multiple purposes: from interactive visualization and virtual musealization to structural simulation and integration into information systems for heritage management. Moreover, having access to a high-precision 3D model allows for ongoing monitoring of potential deformations or deterioration, contributing to the protection and conservation of the monument.

<div align="right">R.B.</div>

IV. THE ROLE AND USE OF MARCELLUS THEATRE 2D AND 3D DIGITAL MODELS

Starting from digital data acquisition and 2D processing, the research subsequently focused on how a 3D digital model can serve as a reliable foundation depending on a specific objectives. The initial step in this second phase was to identify which characteristics of the monument were relevant to the aims of the study, and to determine the most appropriate strategies for their digital representation. The research was initiated in response to a request from the Soprintendenza Capitolina ai Beni Culturali to redesign the theater's lighting system. To this end, the research group was engaged to produce a reference model representing the current state of the monument, thereby providing the company responsible for the lighting renovation with a reliable basis for conducting further simulations.

This required the development of high-fidelity 3D models to simulate lighting scenarios. Given this objective, it became clear that, in addition to morphological and geometrical accuracy, surface roughness and material properties were also essential components to support lighting simulations.

From one perspective, a 3D mesh derived directly from the point cloud would have represented the most accurate means of depicting the actual surfaces. However, this solution presented two significant limitations:

- Methodological limitation: the digital model of the Theater of Marcellus was conceived as a product of critical interpretation, informed by an analysis of its architectural language and an understanding of its historical development—from the original Roman structures, through medieval additions, to modern restoration interventions. A mesh model based solely on point cloud data lacks the capacity to incorporate this interpretive dimension and cannot provide a critical *reading* of the monument.

- Technical limitation: to ensure full usability across different software platforms, the model had to be optimized for seamless visualization and efficient relighting simulation.

Based on these considerations, the adopted modeling strategy began by distinguishing among three primary elements: the original travertine blocks of the theater's façade, the medieval structures with plaster finishes, and the modern tuff (*lapis gabinus*) fornices added during the 1926–1932 restoration works [9,10].

For the original travertine elements, the solution was to retain the mesh surface derived from the point cloud. This choice was consistent with the nature of the surfaces themselves, as the blocks have largely lost their original definition, and the architectural order components are no longer clearly recognizable. The primary feature of these surfaces is their high roughness, which is effectively represented by the mesh. The mesh was obtained by subsapling the point cloud to have one point each 5cm and than interpolate triangular surfaces. This level of detail was coherent with the need of having a easy to navigate model also in the lighting simulation software.

The medieval structures, by contrast, were modeled using NURBS surfaces. This approach aligned with the overall regularity and smoothness of the plastered surfaces. As a result, minor surface irregularities were intentionally disregarded in favor of producing an optimized and easily navigable model. In this case, a low level of approximation was adopted in order to develop a model that accurately reflects the morphological features of the architectural elements in their current state of conservation, including the representation of major irregularities.

For the restoration portions of the first and second architectural orders, the approach involved identifying each component of the architectural order and constructing an idealized model of it. In this case, the restoration aimed to reintroduce, using different materials, a simplified version of the original architectural language applied to the façade—namely, the superimposition of the Doric order at the ground level and the Ionic order on the first level. In this case, all the modeled objects derived from a geometric reconstruction process of each profile.

To correctly represent the sequence of mouldings and define the proportions among individual elements, NURBS curves and surfaces were employed. This choice enabled an analysis of the geometric genesis of each element, comparison with canonical typologies, and subsequent digital reconstruction (fig. 3).
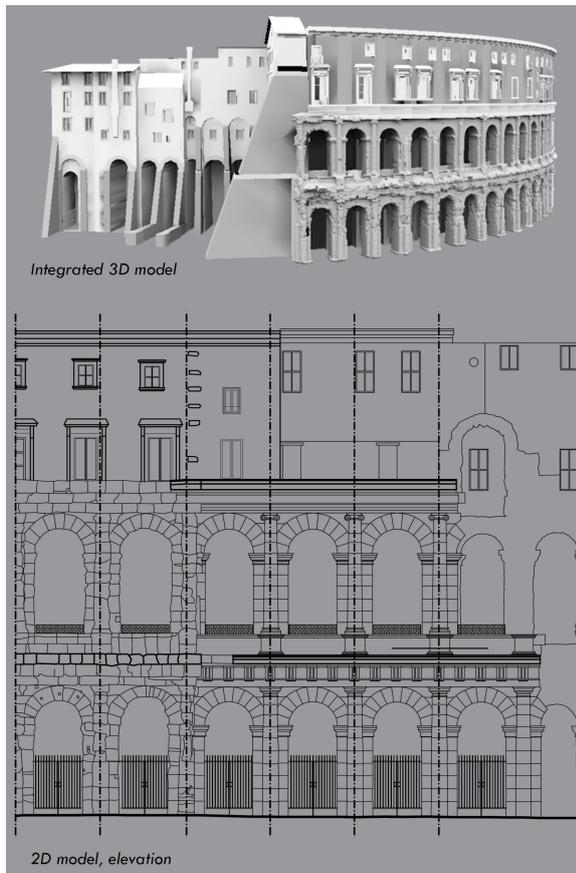
Integrated 3D model

2D model, elevation

Fig. 3. Top: the 3D model of the theatre without material characterization for shape analysis. Down: 2D modelling used as a basis for the 3D model.

Finally, to each material a correspondent colour was assigned to reproduce the chromatic characteristics and predict in a more accurate way their behavior during lighting simulation.

In conclusion, the modeling strategies developed for the Theater of Marcellus demonstrate a scalable and interoperable approach to the digital representation of architectural heritage. By integrating critical, objective, and semantic dimensions into the processes of survey and modeling, the resulting digital artefact responds to both technical requirements—such as lighting simulation—and contributes to the broader epistemological aims of heritage documentation and interpretation (fig. 4).
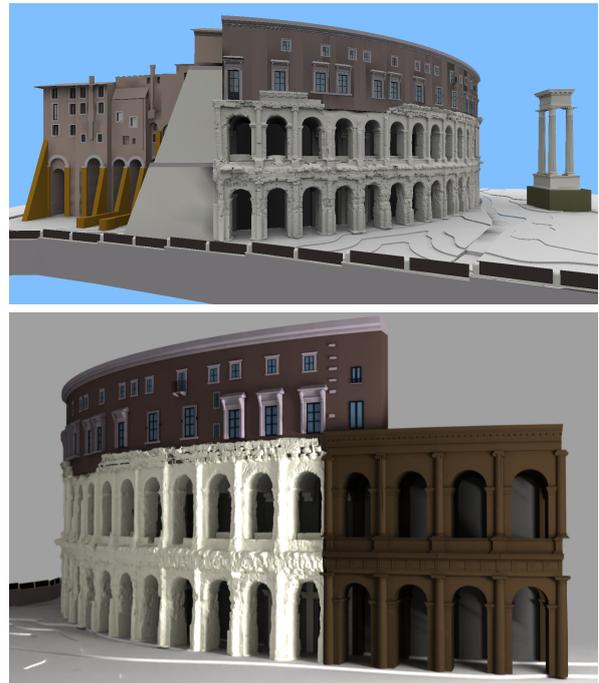

Fig. 4. Two view of the 3D model highlighting the three main material components: the original travertine facade, the medieval structures, and the restoration intervetions

M.G

V. DISCUSSION

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Starting from the initial requirement of developing a model to redesign the lighting system, this integrated modelling approach is also intended to serve as a tool for interrogating the monument itself, both by the general public and by scholars. In the first case, a broader non-expert audience can benefit from the digital exploration of the monument, gaining insights into its main historical phases and virtually assembling or disassembling its various components. Conversely, archaeologists, art historians, and other specialists in architectural heritage can query the model to extract information related to materials, radiometric properties, and other technical aspects. Within this framework, the proposed approach represents a valid alternative to current BIM solutions [11,12] or semantic modelling more in general [13], offering comparable information modelling capabilities while preserving architectural details and surface characterization features.

Building on these results, the next phase of the research will concentrate on extending accessibility and interactivity of the 3D model to a wider audience. The objective is to make the model not only a specialized tool for experts, but also a resource that can be experienced by

the general public in different contexts. On the one hand, this involves providing direct access on site, where visitors could engage with the model as part of the monument's interpretation and educational activities. On the other hand, it also entails making the model available online through established platforms for the 3D visualization of cultural heritage artefacts, such as the ECHOES project [14] and Open Heritage 3D [15]. In this way, the research aims to enhance the dissemination of knowledge, foster engagement with cultural heritage, and promote innovative forms of digital interaction that go beyond traditional modes of communication.

M.G

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