# The Theatre of Pompey: A 3D Jigsaw Puzzle

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The Theatre of Pompey, constructed in 55 BC, was the city of Rome's first permanent theatre and possibly the largest theatre complex ever built. In addition to the theatre, a large colonnaded garden area and *curia* building were erected behind the *frons scaenae* (stage building). A temple dedicated to *Venus Victrix* positioned at the top of the auditorium rose high above the complex. Tertulian, in *De Spectaculis* 10.5, records that Pompey had overcome the traditional resistance at Rome to constructing a permanent theatre by claiming that his structure was actually only a temple dedicated to Venus with a particularly prominent range of steps in front of it from which games honouring the goddess could be viewed. These 'steps' were in fact to become the largest theatre *cavea* (auditorium) ever built.

Today the Theatre of Pompey is largely invisible. The remains of the theatre have been swallowed up by subsequent building programs; what can be identified as belonging to the original structure still survives in basements of and around the Palazzo Pio, off the Campo de' Fiori in Rome. In addition, the modern street plan follows the outline of the ancient theatre.

Over the centuries scholars have been intrigued by the Theatre of Pompey as a physical structure, and many studies have been undertaken; however, these have been based on limited archaeological data. The Theatre of Pompey has also captured the imagination of architects, artists and antiquarians who have created various artistic interpretations of the theatre. One antiquarian in particular, the nineteenth-century, architect Luigi Canina, created a series of hypothetical plans and artistic impressions based on his own investigation of the Theatre of Pompey.

In 1999 the UK's Arts and Humanities Research Board awarded Professor Richard Beacham at the University of Warwick funds to undertake an extensive new study of the Theatre of Pompey, with Prof. Jim Packer, Professor of Classics Emeritus, Northwestern University, USA. Subsequently supported by Northwestern University, the National Endowment for the Humanities and other donors, the on-going project has consisted of five phases:

Phase 1: collating and analysing known historical references and artefacts;
Phase 2: creating 3D computer visualisations of previous architectural studies;
Phase 3: conducting a study of the post-antique history of the site, by Kristin Triff, Associate Professor of Fine Arts, Trinity College, Hartford, USA
Phase 4: carrying out the first ever scientific survey of the site;
Phase 5: an archaeological excavation.

Phases 1-4 are complete. Phase 5, which began in June 2003, will culminate in a more up-to-date, and highly accurate, 3D computer reconstruction of the theatre complex.

This paper reviews the generation of an architectural 3D model based on the plans of Luigi Canina as part of Phase 2, and the problems encountered and 'errors' discovered in his plans. By converting 2D plans into a 3D model, scholars can truly begin to understand and investigate the complexities and intricate detailing recorded by Canina in terms of 'virtually' real architectural space. 3D technologies are the only viable means to offer comprehensible ways of exploring even the smallest facet of architectural detail which would otherwise be obscured in 2D graphic representations.

Through the process of transforming Canina's 2D plans into a detailed 3D model, inaccuracies in the plans were exposed in a way that could only clearly be seen and understood in 3D. Canina's architectural plans, although they appear to match up and align with each other, in fact began to manifest some major inconsistencies in the measurements, leading to architectural anomalies. Although Canina's plans and drawings are hypothetical and never meant to be realized in 3D, they still constitute a serious study of the ancient theatre, but, simply put, the Theatre of Pompey would not have stood up had it been built from Canina's plans. The inconsistencies in Canina's plans were hidden (deliberately or otherwise) by the ambiguities inherent in 2D graphical representations of 3D space. Only through hours of study and comparing each plan for specific inconsistencies might these errors have come to light. The process of computer modelling, unlike 2D depictions, is unremitting in that components fit together precisely in 3D.

The main inconsistencies between Luigi Canina's drawings of the *Elevazione Verso La Cavea* (internal cross-section) and the *Pianta del Piano Superiore* (plan) as revealed by 3D modelling can be seen in Table 1.

| | **Internal cross-section** | **Plan** |
|---|---|---|
| Lower *Cavea* | 16 seats | 14 seats |
| Upper *Cavea* | 24 seats | 23 seats |
| *Praecinctio* | 3.1m depth (from front of seat to back of the praecinctio)<br><br>Appears to curve along the entire cavea | 5.5m depth (from front of seat to back of the *praecinctio*)<br><br>Breaks either side of the temple steps |
| *Praecinctio* steps | 5 steps | 4 steps |
| *Porticus* | Space between mid cavea and porticus is 5m<br><br>6 seats<br><br>Columns are positioned at foot of seats | Space between mid *cavea* and *porticus* is 3m<br><br>7 seats<br><br>Columns are positioned after third row of seats |
| Temple | 6 round columns<br><br>7 steps at foot of Temple | 4 round columns; 2 end columns appear to be pilasters<br><br>6 steps at foot of Temple |
| *Versurae* | Engaged columns are shown | No engaged columns are shown, only those on the *frons scaenae* |

**Table 1** Comparison of internal cross-section and plan

The dimensions of the external perimeter of the theatre shown in Canina's plan, internal cross-section and outer elevation remain approximately the same in all drawings, however, the dimensions and number of architectural elements that are represented between the *orchestra* and the outer façade wall of the theatre vary considerably. A major disparity can be calculated in the seating arrangements that are depicted in both cross-section and plan. The plan contains fewer rows of seats. Canina has made up for the space lost by the absence of these rows by increasing the depth of other architectural elements. An example of this is the *praecinctio* which is over 2m wider in the plan than shown in the side elevation.

Another inconsistency can be seen in Canina's positioning of the columns around the *porticus summa cavea*. The plan (**Fig. 1**, right image) shows columns in a peculiar configuration, situated mid-way down the incline of the seats of the *porticus*. In the side elevation (**Fig. 1**, left image) by contrast, the columns are positioned level with the lowest *porticus* seats, which accords with conventional Roman architectural practice.

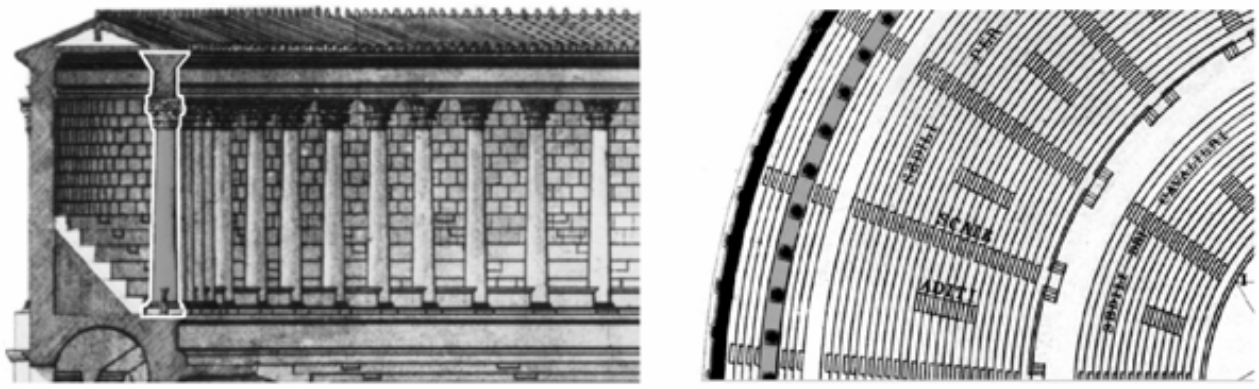


**Fig. 1** Left image showing side elevation with columns positioned at the front of the *porticus*.
Right image showing plan with columns positioned mid-way through the *porticus*.

Another peculiarity is evident in the *cavea*. The Roman architect Vitruvius, writing late in the first century B.C., presented in Book 5 of *De Architectura*, a detailed description of the geometric layout of an ideal Roman theatre, based upon a series of mathematical *formulae*. Canina has drawn a 'Vitruvian' formulaic circle inside the *orchestra* showing that he is using the 'Vitruvian Ideal' as the basis of his theatre (*De Architectura* 4.6.1). However, Canina is inconsistent in his use of this formula; the centre of the Vitruvian circle is not actually used to determine the central coordinating point; instead, a different point of origin, approximately 2m behind the central axis of the circle, is used as shown in **Fig. 2.**

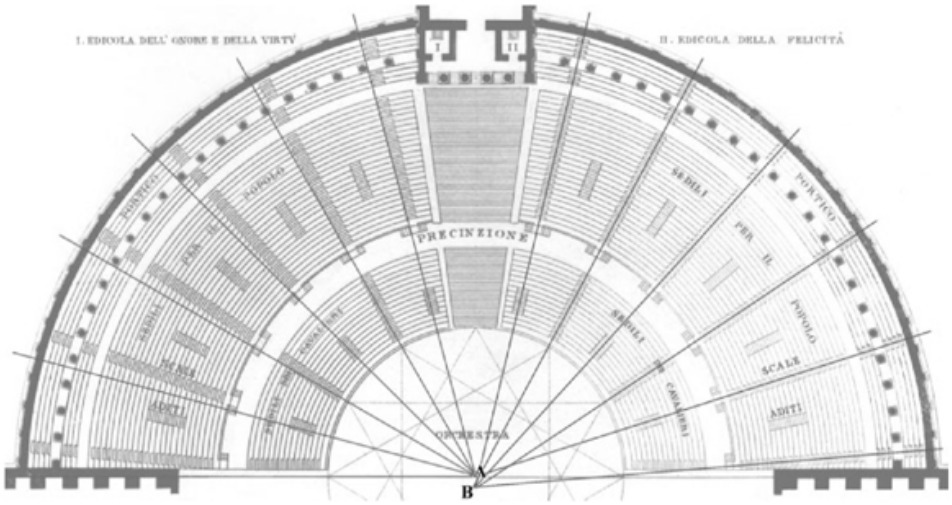


**Fig. 2** Image showing Canina's use of the Vitruvian circle.
**A** shows the point of origin for the Vitruvian ideal. **B** shows Canina's actual point of origin.

Canina's misplaced central point of origin results in the *cavea* steps running slightly askew, and produces an unusual wedge of seats located in the gap adjacent to the stairways closest to the *versura* that measures approximately 2m at the uppermost end of the stairs, but which then narrows down to 0m where the steps connect to the *praecinctio*. It is exceedingly unlikely that the theatre contained such an inelegant architectural anomaly, a conclusion borne out by studies of comparable Roman theatres.

In order to create a 3D reconstruction of the Theatre based on Canina's drawings, the majority of the required measurements were taken from the internal cross-section drawings since these represented two dimensions, vertical and horizontal. An attempt to use a combination of measurements derived variously from both the plan and the outer and internal plans would have resulted in a badly-aligned architectural structure.

The consequent 3D model, however, highlights even more problems arising from possible errors in Canina's 2D drawings. One of these is the locations of the massive range of steps running down from the temple crowning the highest point of the theatre. According to Suetonius (*Claudius* 21.1-3), the Emperor Claudius on one occasion opened games by first sacrificing at the temple, and then descending slowly down the central stairway through all the tiers of seats to take his place in the *orchestra*, while the thousands of spectators stood in silence. However, in the 3D reconstruction it can clearly be seen that, according to Canina's drawings, this stairway at its base does not actually connect with the *orchestra*. The *praecinctio* that runs around the perimeter of the *cavea* cuts through the temple steps by creating a barrier wall approximately 1.5m high. **Fig. 3** shows this point clearly, whereas in Canina's plans it is obscured, and consequently very difficult to perceive the relationship that Canina's structure demands between the temple's steps and the seating in the *cavea*. However, Canina's attempt at 3D realism in his artistic drawing of the auditorium (**Fig. 4**) does show the steps connecting the orchestra to the temple.

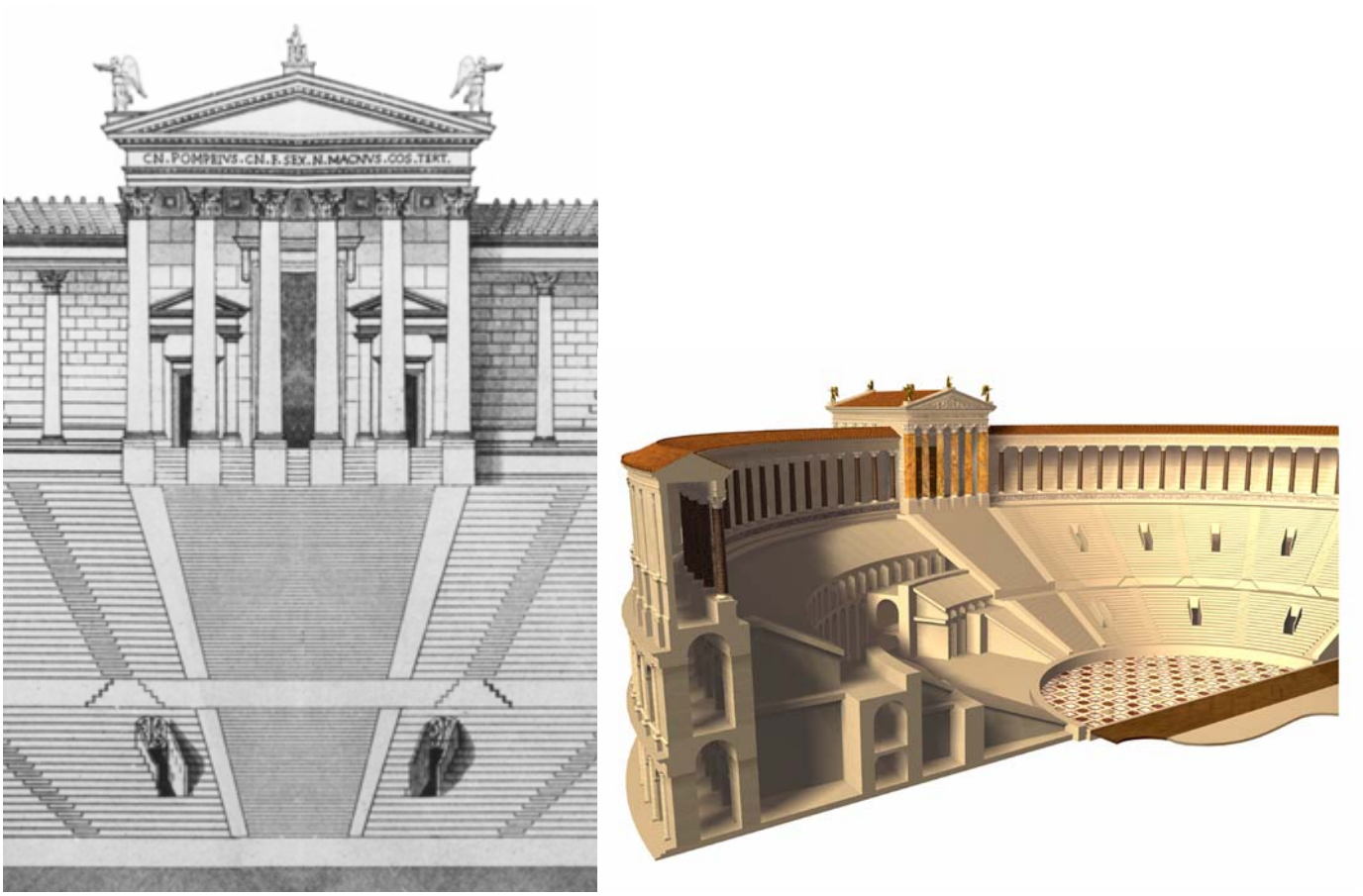


**Fig. 3** Left image showing relationship of temple steps in the Canina's cross-section plan.
Right image of showing cut-away computer model, highlighting temple steps relationship in 3D.

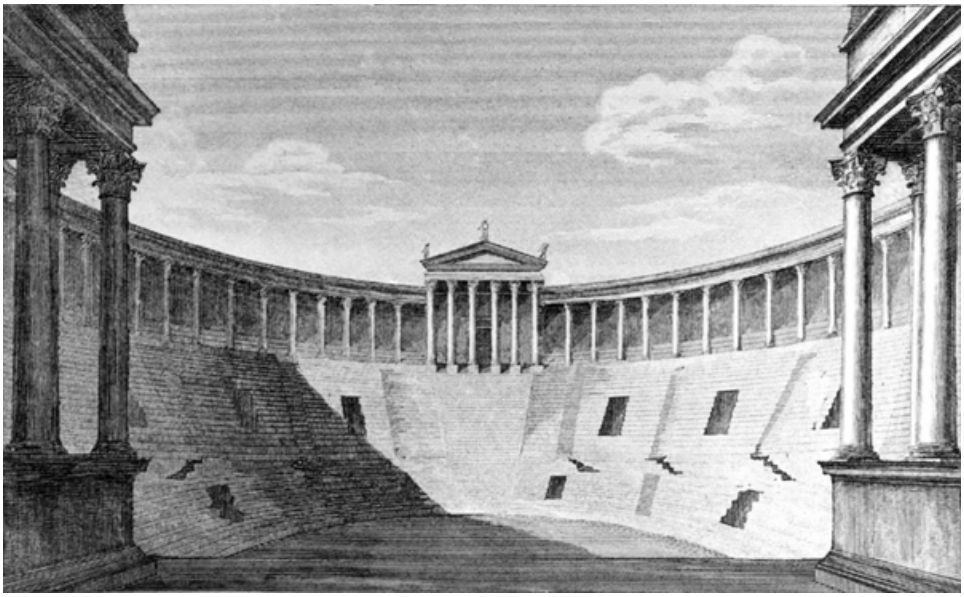

**Fig. 4** Artistic drawing by Canina showing the relationship of the temple steps in the auditorium.

Following on from Canina's study of the theatre, other scholars, including Baltard of the École des Beaux Arts, have added more and more illustrious interpretations to try and capture the essence of the theatre. Working closely with Roman archaeological specialist James Packer, we are able to go one step further by applying marble textures and architectural ornamentation to the 3D reconstruction of Canina's 2D drawings, based on actual archaeological evidence from the site. These include *porphyry, giallo antico, granito* marbles, and fragments of architectural mouldings. Using extant evidence from surviving Roman buildings and using known Roman formulaic construction methods (orders of architecture) as written about by Vitruvius, we have been able to build upon, and add to, Canina's original study of the theatre, thus providing a new and more detailed version (**Fig. 5).**

**Fig. 5** 3D rendering of the Canina model, showing the application of marble textures and ornamentation.

## Conclusion

The advent of 3D and VR technology can now enable us to not only investigate the theatre as a standing structure, but also offers us an understanding of the sightlines of the performance space, lighting conditions, and acoustic levels. It also presents us with the ability to calculate audience capacities and raises myriad other questions that would have been difficult or imposible for previous scholars to address or, in some cases, even to formulate.

The resultant 3D model based on Canina's drawings does not illustrate his work; it corrects and enhances it by unifying the research into a coherent whole. This in turn enables Canina's hypotheses, and their problems, to be visualised more accurately, and in turn, this becomes a useful hypothesis in which to situate our own original research and contribute to a new 3D reconstruction as part of phase 5 of the Theatre of Pompey Project.

To view the 3D reconstruction in real-time, please visit: http://www.kvl.cch.kcl.ac.uk/pompey.html.

*Martin Blazeby is a Senior Research Fellow in the 3D Visualisation Centre, University of Warwick. [Ed. Note: This information was correct as of Summer 2005. Since September 2005, Blazeby has been Senior Research Fellow in King's Visualisation Lab, Centre for Computing in the Humanities, King's College London. See:* http://www.kvl.cch.kcl.ac.uk/*]*