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BETWEEN SPATIAL AND ARCHIVAL DATA: DIGITAL HUMANITIES FOR THE HISTORY OF A STAIRCASE OF PITTI PALACE

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ABSTRACT:

In the last decades, surveys produced with geomatic techniques are increasingly used for the study and conservation of the built heritage because they automatically collect large amounts of data with an accuracy and objectivity that could not be achieved with traditional techniques. As in other fields of digital and spatial humanities, the combination of spatial data with archival and secondary sources provides new tools for reconstructing the history, construction, and transformation of a historic architecture.
The new digital survey of Pitti Palace, which was carried out between 2019 and 2021, has revealed aspects neglected by previous surveys and historical studies. Pitti Palace is the largest historical civil building in Florence. In the 16th century, Bartolomeo Ammannati carried out important extensions, including the so-called "spiral staircase", one of the most important staircases in the palace. This staircase, of which there is little documentation, although it is considered a masterpiece, was demolished at the beginning of the 19th century by Pasquale Poccianti to make way for the "New Secondary Staircase", on which previous studies have focused mainly on stylistic and decorative aspects.
Using digital spatial data as a primary source, the research aimed to explain the construction history of the new staircase built by Poccianti, allowing a precise comparison between the archive documents and the actual geometry of the building elements.
It also highlights previously undocumented features, including the evidence for the Ammannati staircase and the important changes made during the construction of the new staircase. The article shows how the insertion of the new staircase profoundly altered the design, structure and layout of a wing of the Pitti Palace. It also suggests how a more transdisciplinary and holistic approach helps the study of historical architecture.

1. INTRODUCTION

Surveying has always been the main tool for architects' training and the study of architecture (Tucci et al., 2016). However, regardless of the measurement technique, surveying a large architectural complex has always been a time-consuming and laborious process. It is still common practice to survey only the part of the building that is to be changed and to add the new amendments to older plans. Moreover, before the mechanical reproduction of drawings, manual duplication could lead to an uncontrolled accumulation of errors and deformations.
The result is that many large heritage buildings lack up-to-date, complete, and metrically reliable surveys, and therefore both routine management and maintenance, and sometimes scientific research, are carried out on an unreliable basis. Although the design and execution of the survey of complex architecture are still challenging, geomatic techniques allow for faster and more complete fieldwork. Dense, automatic surface scanning allows measurement of inaccessible points, e. g. room heights. Another feature is that everything recorded in a point cloud is intuitively recognisable; as well as the geometry of the architectural elements, the state of conservation, fixtures and fittings, furniture, equipment, etc. are also included with their exact spatial position within the building. These natively digital data offer the possibility of realising traditional 2D drawings, 3D models and, more importantly, information systems that can link all the data to a geometric representation of the building according to the paradigms of Building Information Models (BIM), Geographic Information Systems (GIS) or Digital Twins (Pamart et al., 2023).
At the same time, space and place are becoming increasingly important in traditionally humanistic fields. Geohumanities combine textual and archival data with other primary sources, such as geospatial data (Bodenhamer et al., 2010). They intersect qualitative and quantitative methods to explore new areas of research or to re-examine existing data from new perspectives. At the territorial scale, GIS are the main tools used, while at larger scales 3D modelling or BIM are also applied (Travis, 2020; Tucci et al., 2021).
This paper aims to show how combining geospatial data with archival and secondary sources provides new tools for reconstructing the history, construction, and transformation of a heritage building. The new complete survey of Pitti Palace, carried out between 2019 and 2021, integrated terrestrial and UAV photogrammetry and laser scanning within a control network measured by GPS and total station. The resulting spatial data revealed aspects overlooked by earlier investigations, both historical studies and previous surveys.

2. PITTI PALACE

Pitti Palace is the largest civil heritage building in Florence. The original core was commissioned by Luca Pitti and built around 1452, possibly to a design by Filippo Brunelleschi (Sanpaolesi, 1968; Romby and Ferretti, 2002). The map by Pietro del Massaio (c. 1470) shows it on the slopes of Boboli hill, close to a pre-existing quarry, the same one used for the construction of its massive walls and facades (Chiarini, 2000). The fresco of the Siege of Florence by Giorgio Vasari shows there was the so-called "old house", also belonging to the Pitti family, behind the new palace (Matracchi et al., 2015). In 1549, Eleonor of Toledo, wife of Cosimo de' Medici (the future first Grand Duke of Tuscany) bought the entire property. The palace was already three storeys high, but the interior was probably still under

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construction. A fresco in Michelozzo's courtyard in *Palazzo Vecchio* shows the many works promoted by the Medici, the connection with the old house, the expansion of the palace, and the creation of the Boboli Gardens (Belli, 2006). Bartolomeo Ammannati was commissioned to design a new courtyard. He built first the north wing, then the doubling of the original core and finally, after the demolition of the old house, the south wing. Next to it, as seen in Giusto Utens' lunette, a service block with kitchens and ancillary rooms was built (Baldini and Ferretti, 2011).

Over the years, the building grew in importance and was used not only as a residence but also as the seat of the government. In the 17th century, Giulio Parigi and his son Alfonso enlarged the main body, which overlooks the square and completed the building in its present shape, except for the two rondos built during the Lorraine period (Smalzi, 2010; Zangheri, 1974a; Zangheri, 1974b). Finally, the *"Palazzina della Meridiana"* was built at the beginning of the 19th century. Facing the garden rather than the square, it was designed to be a more comfortable and modern residence than the palace and therefore better suited to the royal family's needs (Ciseri, 2003). After the Second World War, the palace became state property. Today, it houses five museums and several public cultural institutions (https://www.uffizi.it/palazzo-pitti).

It is a large building that has changed use and ownership over time but above all a complex building with fragmentary and sporadic documentation. The focus on the works of art contained in the palace takes precedence over the documentation of the building in which they are housed. As a result, the process of knowledge, management and conservation has become hardly sustainable.

There is a lot of available data (archival and bibliographic documents, maps, etc.) but it is difficult to find, unorganised and, above all, not referenced to the spaces of the building. The most obvious reason is the lack of reliable 3D spatial data that can be implemented and updated over time, not only to map the various sources on it but also to reinterpret, verify and link them together from a new viewpoint (Breunig et al., 2020; Ramos Sánchez et al., 2022)

This awareness led the Uffizi Galleries (under the direction of Dr Eike Schmidt) to fill this gap. In 2020, Pitti Palace was the subject of an extensive 3D survey campaign carried out by the Geco Lab of the University of Florence as part of a research agreement. The campaign included the implementation of a control network carried out with well-established topographic systems (GPS and total station) and the use of 3D scanning and Structure-from-Motion (SfM) photogrammetry for the architectural survey (Bonora et al., 2021).

All the interior and exterior spaces of the palace have been documented, not only in terms of their geometric features but also in terms of their management, use, current and past designations, finishes, materials, and state of conservation. In other words, a 3D information system was designed to support knowledge of the building and its future management and maintenance (Bonora et al., 2023).

3. THE CASE STUDY

The availability of a 3D digital model suggested a re-reading of the documentation collected on two monumental staircases in the north wing of the palace: the so-called "Snail Staircase" by Bartolomeo Ammannati and the "New Secondary Staircase" by Pasquale Poccianti, which replaced it in the 19th century. These were important works commissioned by two grand dukes, Cosimo I and Ferdinando III of Lorraine, to some of the best Florentine architects of their time. They are important architectural elements used for many different purposes and should be thought of as the connective tissue of a very complex machine. In fact, we should not only think of the palace as a residence and seat of government, but we could also say that staircases at that time fulfilled the function of the modern service risers.

They were constantly traversed by a multitude of people engaged in daily activities that are now obsolete: operating lighting systems, servicing stoves and fireplaces, manually transporting and storing goods, preparing food in kitchens, maintaining sanitation facilities, and so on (Piacenti, 1977; Bertelli, 2002; Contini and Gori, 2004).

There are more than seventy staircases in the palace; for these reasons, they were carefully listed and ordered according to their function and importance. In the 17th century, for example, Marmi in his *"Norma per il guardaroba"* describes staircases as well as rooms (Marmi, 1662). The rooms were catalogued with a letter, while the staircases were identified with the same number on each floor. In particular, the legend indicated the parts connected by each staircase and the connections between the main and secondary staircases. As late as the 1770s, a *"cabreo"* shows and catalogues the scales in a similar way (Contini and Gori, 2004). The two scales have had alternating critical reception over time, so it has been interesting to verify the reliability and soundness of scholars' opinions. A critical reinterpretation that is still based on documentary sources but with the support of measurements, with the aim of assessing the construction, statics, and spatial organisation of the staircases and the rooms around them, beyond considerations of style and decoration.

4. RESEARCH METODOLOGY

The study examined primary and secondary sources, both textual and visual, in particular the historical plans showing the two staircases. The maps have been compared with the new survey to study the transformation of the building over time; in particular, we have examined the following maps, views and drawings:

- 1500 Bartolomeo Ammannati, *Alzato per il cortile di Palazzo Pitti*. (Ammannati, 1500)
- 1574 (Parigi et al., 1547)
- 1628 (Futtenbach, 1628)
- 1571-1635 (Parigi, 1635)
- 1632 Cantagallina R., *Palazzo Pitti durante i lavori di ampliamento*. (Chiarini, 2000)
- 1650 Marmi, D. M. (Marmi, 1650)
- 1662 Marmi, D. M. (Marmi, 1662)
- 1742 Ruggeri G. (Ruggieri, 1742)
- 1774 Fallani B. (Fallani, 1774)
- 1810 Poccianti P. (Poccianti, 1810)

This was mainly a qualitative reconstruction, as all the drawings are locally deformed for the reasons mentioned above, making reliable georeferencing impossible.

They are drawings in different scales and made for different purposes, in which the staircases are always shown in a schematic way. A key point is that the height of the main floors must have remained unchanged over time.

The distance between each of the three main floors of the building is approximately 12 metres. In many cases, there are mezzanines above the main rooms, with service rooms or cavities above the vaults, but the characteristics of the construction indicate that the height of floors has not changed. This made it possible to estimate the slope of the flights with certainty, even though, for example, ancient plans differ in the number of steps.

5. AMMANNATI “SNAIL STAIRCASE”

Bartolomeo Ammannati began his additions from the wing where he built the so-called “snail staircase', so it probably also played an important role during the construction process. It consisted of a series of flights with different lengths connected by half spirals. Along the flights of stairs, other secondary staircases led to the service floors in between.

In the past, two scholars have reconstructed the layout of the staircase (Fossi, 1967; Facchinetti Bottai, 1979). Their sketches do not consider the actual differences in height and are not dimensioned. They should be considered as simplified drafts; the inclination of the flights is not correct and some secondary doors and staircases are omitted.

On the two lower floors, the flights were wider and separated only by a central wall.

The landing on the first floor gave access to the Reliquary Chapel and to a large room, the *"Sala della Guardia"* (the “Guards’ Lounge”), which was originally a loggia overlooking the courtyard (Ammannati, 1500).

Continuing to the third floor, the staircase had narrower flights, with a small room in between. Finally, the staircase was even narrower and led to the attics inhabited by servants.

As evidenced by two letters from the architect to Cosimo I in 1563, the rock of the existing quarry was specifically carved to build the staircase (Gaye, 1839). Two years later, work on the south wing had reached the first floor. The staircase was completed in 1576.

There are no interior views of the staircase. A 17th-century view of Remigio Cantagallina, shows the volume from the rear, before the addition of another building. Drawings by Ferdinando Ruggeri (Ruggeri, 1755) show that the staircase started below the courtyard loggia, probably to cross the rocky outcrops.

Many plans show only the main floors used by the court and not the mezzanines used by the servants, so the staircase is not entirely visible. The plans drawn by Bernardo Fallani in 1774 have been used to model the Ammannati staircase, because they show all the floors, and the 17th-century sketches by Giulio Parigi because they are closer to the original and contain many interesting comments.

The staircase has been reconstructed focusing on the construction characteristics based on reliable elements. Any assumption on finishes and ornaments has been avoided as there is no documentation.

The 3D model demonstrates that the flights of the stair had very different gradients, between 30% and 60%. The paths of the court and the servants were intermingled, but the service staircases had an even steeper gradient and many of them began directly in the middle of a flight with no landing. With a wall between the two flights of stairs and windows only on one of the short sides, the staircase must have been quite dark.

The Ammannati’s “snail staircase”, therefore, had an articulated and unusual layout. Although praised by some scholars as a masterpiece, it was demolished in the early 19th century. Surely today's sensitivity to heritage would prevent demolishing a famous architect's staircase in a historic building, but the 3D reconstruction shows that it must have been uncomfortable. If it

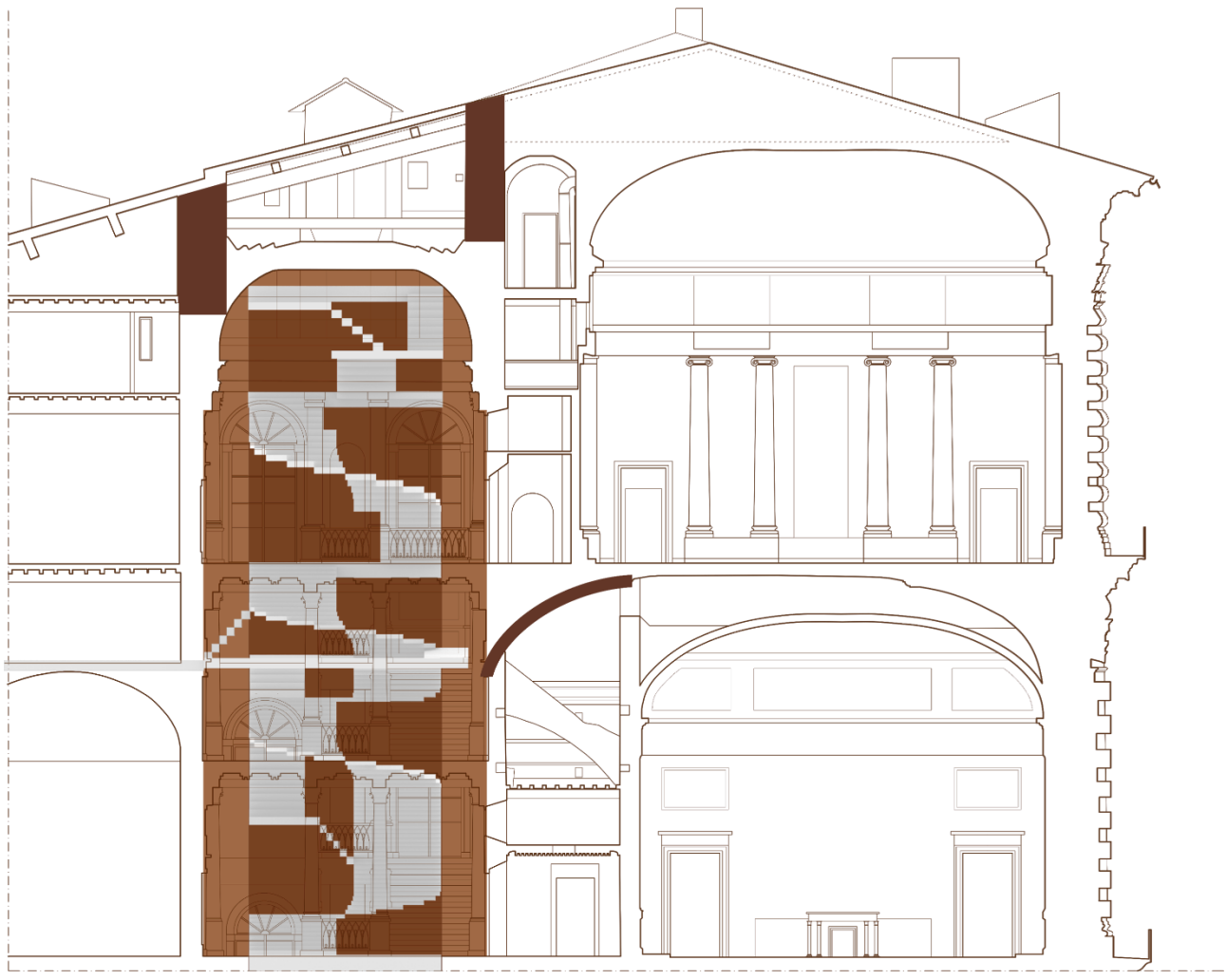

Figure 1. Overlapping of the reconstructive model of the “snail staircase” with the actual state. Highlighted in brown is the greater thickness of the walls on the upper floors and the ancient vault of the *“Sala della Guardia”* cut-off on the side of the new staircase.

was acceptable in the 16th century, it is understandable that some defects were no longer compatible with the lifestyle of a modern 19th-century court.

6. THE POCCIANTI’S STAIRCASE

The design and construction of the 'New Secondary Staircase' (Morolli, 1974), the main staircase of the palace is the one in the south wing) involved Pasquale Poccianti from 1815 to 1847. The long duration of the work was undoubtedly due to budgetary constraints (as evidenced by the accounting data, as described in the documents of the *Scrittoio Fortezze e Fabbriche, Fabbriche lorenesi (ASF)*), but probably also to construction problems that can only be intuited by comparing the sparse technical notes with the actual situation as it was surveyed. Poccianti created an open well staircase with long ramps alternating with landings.

In the first version, the staircase would start halfway up the covered passage that Poccianti had designed between the two main courtyards of the palace. The staircase had already been partially built according to this design when it was decided to demolish it in order to move the entrance to the central courtyard.

The reason for this change is not documented, but it may be that the first flights without windows were still too dark, as the staircase started partly underground (as mentioned, Ammannati excavated the bedrock to make the previous one). It must have been a difficult and expensive decision, since it damaged the exquisite *"Mezzanino della Muletta"* and made it inaccessible.

The final staircase, on the other hand, is spacious and well-lit, thanks to large windows on one side and two skylights at the top (Fossi, 1970).

With minor corrections in the number of steps and gradients, the staircase flights are comfortable, and the heights of the main floors are respected (Maggiordomo and Zivillica, 1974)

According to the neoclassical style, Ionic, Doric and Corinthian columns are superimposed, but Poccianti has originally reinterpreted the classical orders. The entire staircase is made up of perfectly carved and assembled elements of *“pietra serena”* stone, demonstrating meticulous attention to detail. (Bietoletti, 2010)

The survey revealed that the volume of the staircase was greater than the previous one, which was possible because the surrounding walls were thinner (Figure 1).

The thinning of the existing walls (or their reconstruction) and Poccianti's precautions against instability must have had a major impact on the time and cost of the building site. In 1826, when the staircase had already been built up to the first floor, the architect ordered two slabs of exceptional size (more than 4 m x 2.5 m x 0.6 m).

By comparing the dimensions of these blocks with the actual dimensions of the staircase elements, it has been concluded that these stones were intended for the construction of one-piece landings, probably to strengthen the structure at its weakest points and improve the support of the staircase flights.

The most significant interventions concern the transformation of the rooms on the first and second floors facing Ammannati’s courtyard.

As early as 1813, Giuseppe Cacialli designed the *“Sala di Ercole”* (“Hall of Hercules”) and a small antechamber by reducing the old *“Sala della Guardia”*. The survey revealed that the vault of the latter still exists and is visible in the cavity above the vault of the new hall.

The old vault, of which the surrounding cornice remains, has however been cut off on the side of the new staircase.

In the space between the old hall and the new one, a rampart arch was placed (probably by Poccianti) to reinforce the wall of the staircase (Figure 2).

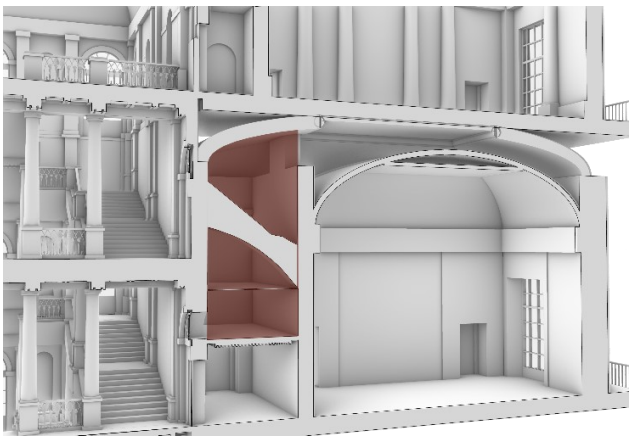

Figure 2. Three-dimensional model of the Poccianti’s staircase and neighbouring rooms on the first floor. Highlighted in red is the resulting space with the rampant arch.

Even on the second floor, where Poccianti designed a Ballroom above the *“Sala di Ercole”*, the layout is the same. The last floor, which should have been the highlight of the staircase, is instead rather disappointing, as the many design variations in the archive attest.

The Ballroom is very simple and without the planned decorations. The access was through a small vestibule like the one next to the *“Sala di Ercole”* on the lower floor. It was an unimpressive entrance for a royal court hall, barely allowing the passage of a lady in a ceremonial dress with a diameter of about 150 cm. The survey revealed that there is a small room above it, originally conceived as a loggia for the orchestra.

A sketch shows that it should have had a steep staircase for access, but the room, which can only be entered through a trap door, is completely unfinished, and the balcony overlooking the ballroom is closed off by a panel of fabric (Fossi, 1970) (Figure 3).

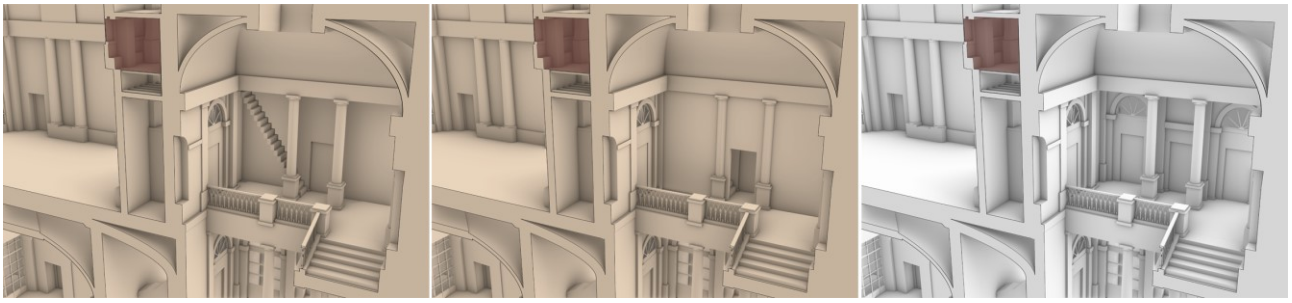

Figure 3. The Poccianti’s staircase on the second floor. The incomplete orchestra room is highlighted in red. On the left is a reconstruction of the staircase that led to the orchestra room; in the center is a reconstruction of what the lobby should look like according to Poccianti's project; on the right is the current state.

The 'New Secondary Staircase' ends on the second floor. Above it, on the attic floor, is the extrados of the vault covering the staircase and the structure of the skylights that illuminate it.
The surrounding walls of this level are much thicker than those of the floors below, a discrepancy that testifies to the thinning that Poccianti carried out on the lower floors to enlarge the staircase.

7. CONCLUSION AND PERSPECTIVES

A Renaissance staircase in one of Florence's most famous palaces has been replaced by a grand Neoclassical one. These works of art and transformations are already well known, but so far scholars have only focused on certain aspects, mainly textual documents and stylistic features.
The spatial data obtained with a 3D survey, intended for other purposes, led to a comparison of already known documents and the physical and material characteristics of the building from previously neglected and novel perspectives (Figure 4).
As with other applications of the Geohumanities, this research would sometimes have been possible without the help of innovative technologies or computer systems, but it only became a reality when these tools changed our approach to knowledge.
In addition, the case study presented concerns only a small part of the Pitti Palace. The possibility of extending the use of this method to the whole palace, or to the many other built heritage sites that still lack reliable metric documentation, depends on the possibility of building information systems in which spatial data are linked to other types of data, including textual and graphical data already present in archives and libraries.

Figure 4. 3D model of the “snail staircase” (a); 3D model of the Poccianti’s staircase (b) and the resulting overlap between the two stairs.

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