The graphic sign for historical narration of architecture. The fortifications of the Liri Valley

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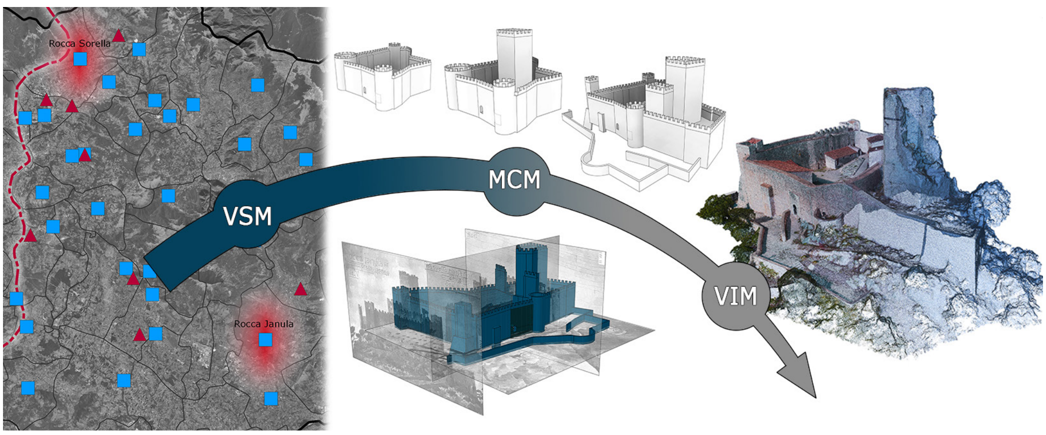
Abstract

Communication by image is the most immediate and intuitive especially if based on the semiotic structure thus generating "meaningful images" that relate to the referent/signifier/signified. Starting from this assumption, the paper defines three levels of graphic communication that can be adapted to convey historical information about architecture. The three levels, therefore, generate as many graphic models that produce virtual, mental, and visual images, which relate geometries and colors with the certainty of historical data. The virtual model uses symbols to aid in the understanding of a large and complex real phenomenon. Its feature is denotative/metalinguistic and can be produced, for example, in a GIS environment. The mental model uses clues to visualize uncertain data such as hypotheses of the historical evolution of architectures or information drawn from written sources. It is a denotative model based on simplified monochromatic geometry. The visual model, also denotative, uses icons that reproduce the real object exactly as it is. The reproduced object has a textured or photorealistic visualization and therefore can communicate the certainty of the data. The defined procedure was applied to the case study of fortifications in southern Lazio.

Keywords
Semiotic signs, fortresses, 3D model, survey



The three-level procedure for historical narration of architectural objects

doi.org/10.3280/oa-832-c62

The graphic sign for historical narration

Facing with remains of architecture, the observer elaborates on an image in his mind, reproducing a possible reconstruction of the real object as it was in the past. This is because everyone has an accumulated stock of images throughout their life: conscious and unconscious images, distant from early childhood, and close images associated with emotions [Munari 2000, p. 19]. This image or reproduction, as emotional, is neither realistic nor objective and could induce the observer to communicate a message that does not respond to reality. This is particularly wrong in the case of the historical narration of an architectural asset, which, on the other hand, requires a more denotative or referential communication. If performed with the use of images, the latter also becomes immediate and more easily transmitted to everyone, even the less experienced. The drawing works well because it represents the actual object as an icon or rather reproduces its formal, geometric, chromatic, and proportional qualities. Therefore, it is of great help in understanding the real phenomenon since it generates "meaningful images" with signs based on a precise grammatical structure and a uniquely determined visual code. In short, the drawing relates the signifier with the referent and/or the signifier with the signified based on precise rules (fig. 01).

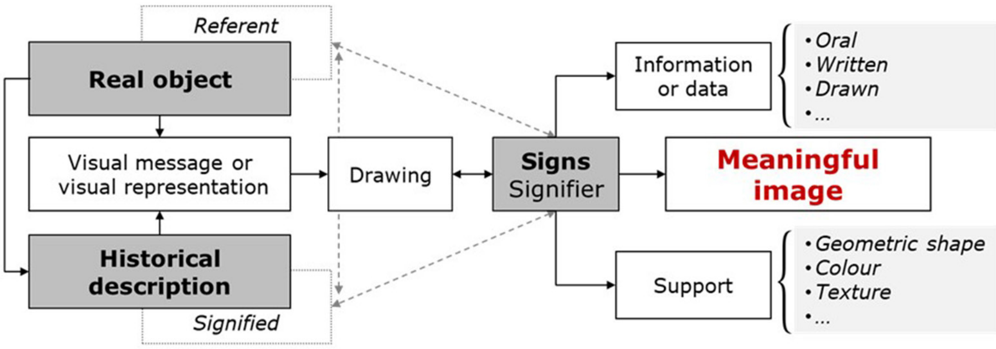


Fig. 01. Drawing by the authors. Semiotic scheme of a meaningful image.

Furthermore, according to Martin Joly, the drawing returns a "visual representation" of the real object, "something that looks like something else," and it does so by crossing the different meanings of the "image", a mental-virtual-visual image [Joly 2008 pp. 44-79]. Developing this statement, a real object can be represented by different models derived from further use of colour and geometry. A simplified geometric and monochromatic model (e.g., CAD or BIM) creates, for example, a mental image as it uses clues that have a logical affinity relationship between the signs and what they represent (referent). The model conveys the "idea of the object" but does not make it realistically visible. For this reason, it is particularly effective, for example, in reproducing historical, hypothetical, or uncertain data as written sources since its features suggest the idea of a hypothesis rather than the certainty of the data. A further model, based on symbols, which are found in a conventional relationship between the signs and the referent, produces a virtual image, helping to understand even extensive and complex real phenomena. GIS, H-BIM, mesh, cloud point, and so on, are models that, born from the integration between heterogeneous survey data and historical sources, consciously project the observer into a virtual dimension. At this point, the virtual image, thus generated, has an exclusively epistemic function even if the images produced are also metalinguistic since they explain, interpret, and comment on the signs with other signs, communicating on communication [Joly 2008, pp. 44-79].
The most intuitive model is undoubtedly the iconic one since it reproduces a visual image in which the real object appears exactly as it is. The icon creates an analogical relationship between the signs of the signifier and the referent. Generally, the texture is applied to the model to obtain photorealistic features that facilitate the reading and analysis of the material qualities and the spatial relationships between the object's components [Arnheim 2020].

A model such as e.g. SMF, thanks to its photorealistic chromaticity, transmits information as data certainty, giving the observer a greater critical awareness in analyzing the real object. In summary, a cloud of points obtained with digital photogrammetry, for example, if discretized, returns a virtual image (symbol) of the real object, if reworked a mental image (clue) and if texturized a visual image (icon).

The three-level procedure for historical narration

Having said this, based on the denotative/metalinguistic function of visual representation, a procedure has been defined for the historical narration of architectural artifacts that have undergone multiple vicissitudes over the centuries. The case studies concern the fortifications of the Liri Valley. The phenomenon must be narrated starting from its dimensional consistency up to the events of the single architectural artifacts (towers, fortresses, and castles). The procedure aims to describe its most correct historical evolution using the three different structures of the images since the historical sources, especially the origins, are very lacking. The procedure relates the shapes and colours of the reproduction/image of the real object with the level of historical knowledge acquired from specific sources and by the survey. For this purpose, three linguistic levels of the graphic model have been defined (fig. 02).

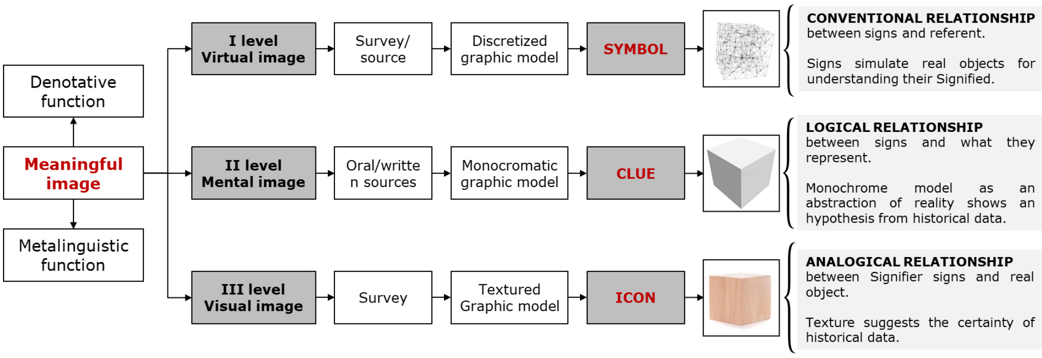


Fig. 02. Drawing by the authors. Procedure scheme for the narration of the historical evolution of architecture. The diagram shows the three linguistic levels (types of images) to which three graphic models (based on symbol, clue, icon) are associated.

The first level is based on a virtual/symbolic graphic model (VSM), designed in a GIS environment to communicate, through images, information on a large scale of very heterogeneous data. The VSM model, with a denotative/metalinguistic function, simplifies the message with graphic symbols but on certain data (integration of technical and historical maps). Its dynamic and virtual characteristics give the perception and awareness of the real phenomenon, which, given its dimension, can only be managed in a "potentially existing" environment and, therefore, virtual. On single artifacts, the VSM takes on a completely different function. Instead of simplifying communication, the symbols used in the model, eg. discretization, mesh, etc., are technical support and contribute to the creation of the next linguistic level, that is the mental/clue graphic model (MCM).
The latter concerns, in fact, the single architectural artifacts and integrates historical data of different nature, primarily written ones. It is a model that, starting from the current state, through the Scan to Bim procedure, or the traditional survey, is imported into a CAD or H-BIM tool. Aware that no visual communication can be exclusively denotative, the model is reworked based on historical information or hypotheses, stripped of the texture (or photorealistic view), and simplified only to architectural volumes. In this way, the model is perceived as an abstraction from reality and transfers the idea that the historical evolution of its referent is hypothetical. Instead, starting from the assumption that the interpretation of colors, light, and shapes is anthropological, that is, that their perception is cultural and therefore natural [Mitchell 2018, p. 59], the procedure applies this criterion to communicate the certainty of the information (data).

The third linguistic level, which generates a visual/iconic model (VIM) by reproducing the architectural artifact as it is, is based precisely on the anthropological criterion. The visual rendering of the object is based on the acquisition of geometric, material, and dimensional data (certain and objective data), acquired with a Structure from Motion procedure then modeled in 3D, indeed. The model is then texturized or rendered, giving a photorealistic vision and, therefore, very similar to the object's reality.

The case study: the fortifications in the Liri Valley

The procedure was applied to the fortifications of the Liri Valley, a very complex phenomenon that has affected a large geographical region. The understanding of the process that built up this fortified architecture must necessarily start from the geopolitical framework of the time. This phenomenon, named *Incastellamento* (Fortresses phenomenon), concerns the fortification of European villages between the 9th and 12th centuries. The term was codified by Pierre Toubert in his treatise "*Les Structures du Latium medioevale*" [Toubert 1973] but is still quoted, criticized, or modified to the present time. The historical and economic reasons that gave life to the castle are described in great detail in the volume, which is still an essential reference for medieval scholars today, even if recent theories sometimes subvert the order and relationship of the events described by the author. The fortification model introduced by Toubert, which is, for the Lazio region, mainly based on written sources of the archives of the abbeys of Farfa and Subiaco, is characterized by a) the centralization of the population, b) the fortification of the city and c) the formation of a territory, the *territorum castri*, around the fortified site. These three phenomena would have occurred in a few decades during the 10th century. Étienne Hubert's most recent theory defines a framework model that, contrary to Toubert's synchronic polymorphism, would have developed over several decades [Hubert 2000, pp. 583-599]. According to Hubert, in fact, the analysis of the summit sites shows that they would have existed long before the 10th century, that is between the 7th and 8th centuries. Further hypotheses, on the other hand, underline the critical role played by places of worship in the process of social and territorial reorganization that characterized the early Middle Ages. In Lazio, churches and abbeys become vital elements of polarization (fig. 03), activating new processes of social and spatial development [Lauwers 2012, pp. 215-237]. The different theories, however, all converge on the outcome of the fortification

Fig. 03. Elaboration of satellite images that show the close relationship between fortresses and religious buildings. In detail, the two case studies are reported, Rocca Janula and Rocca Sorella, born respectively at the service of the Abbey of Montecassino and the Cathedral of Sora.

which produced a profound transformation of the agricultural landscape in its form, the socio-economic structure, and the demographic distribution. In southern Lazio, numerous fortifications also became whole places for economic exchange, allowing a new circulation of resources.

The Virtual/Symbolic graphic model (VSM)

The different hypotheses on the structure of the fortresses phenomenon however point out a strong relationship between the morphology of the landscape, the topography of the place, the relationship with the polarizing elements, such as churches and castles, and the conformation of the architectural spaces. The Interpretation of such a significant phenomenon must necessarily make use of a virtual model capable of simultaneously restoring the territorial dimensionality and the interrelation of all factors. In the first phase of historical narration, whose only sources are the texts that describe the social aspects and not material realities, the communication must be denotative but at the same time virtual to visualize the complexity of the phenomenon. FortLiriGis, a symbolic virtual model born in a GIS environment, has this goal. The borders of the various duchies of the Liri Valley and all the towers, fortresses/castles have been geolocated inside the borders of the various dioceses, as reported in Toubert's *Carte d'orientation* [Toubert 1973], georeferenced for the overlay with the current cartographic maps (fig. 04). A graphic symbol has been assigned to each element to make it more readable.
The system produces heat maps that provide information on the distances to the main polarizing elements (e.g., churches and abbeys). The model also returns the altimetry, which is essential for understanding the architectural conformation of the individual sites and urban aggregates (*territorium castri*) that are sometimes generated around the fortified core, thus suggesting a hypothesis on the reasons for the origins of these sites. FortLiriGis, which is designed on the metalinguistic indications suggested by the legislation, and created for the web, transfers to the less experienced observer an overview of this important phenomenon (fig. 05). This activates a significant process of enhancement of these sites, most of which currently is in a state of total abandonment. The VSM model is also used in the analysis of individual architectural artifacts both in the GIS and HBIM environments. In this paper, the attention is focused on two defensive architectures, Rocca Janula, a defensive structure of the Abbey of Montecassino, and Rocca Sorella created for the control of a geographically important territory such as Sora. In FortLiriGIS, an alphanumeric and iconographic database is associated with the graphic symbol of each artifact, which collects historical data and displays them with a slideshow. In the case of HBIM models, the geometric structure, acquired as cloud points, is used to bring communication to the next linguistic level or, in many cases, it helps technicians understand not only the signifier of the referent but also its meaning.

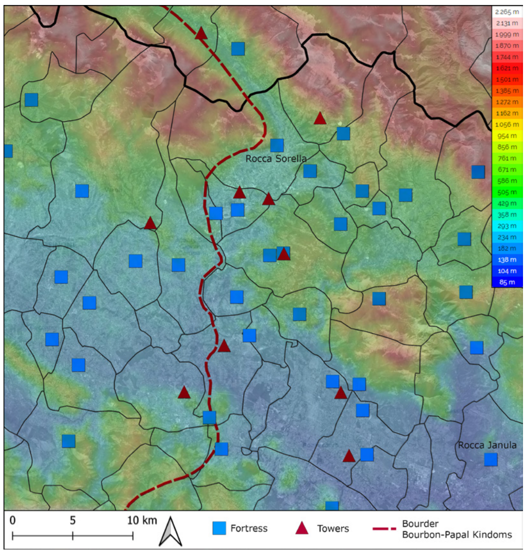


Fig. 04. Elaboration by the authors. In the VSM, the overlap between Tubert's Carte d'orientation showing the boundaries of the duchies of the Liri Valley with the current cartography. Symbolically, the centrality of religious buildings emerges in the fortification process.

Fig. 05. GIS elaboration by the authors. FortLiriGis. The image symbolically shows the consistency of the fortification phenomenon in the border area between the Papal State and the Kingdom of the Two Sicilies

The Mental/Circumstantial graphic model (MCM)

The second linguistic level starts from the VSM and uses a mental/clue graphic model (MCM), which has been fundamental to putting together the historical information of the two fortresses, many of them drawn exclusively from written texts. The dates and reasons for their construction, as well as the original architectural structure, are as uncertain as to the phenomenon of fortification. The only certain data for Rocca Janula is that it suffered partial destruction between 1215 and 1227 following the edict of Frederick II of Swabia, which required the demolition of all the fortified structures of the Kingdom. The same fate probably also affected Rocca Sorella, although there are no certain sources. The history of Rocca Janula, the defensive bulwark of the Benedictine abbey above, is well studied in the careful historical examination carried out by Leonardo Paterna Baldizzi, with the support of the Benedictine father D. Luigi Tosti, on the occasion of the restoration project designed by him, between 1907 and 1910 [Paterna Baldizzi 1913]. On Rocca Sorella, subsequently transformed into the castle known as San Casto, unfortunately, no studies or surveys have been found. The only certain fact is that it had a fundamental role in the Duchy of Sora, an important fiefdom located on the border with the Papal State [Beranger 1981]. From a comparative analysis, some significant similarities emerge as a) both fortresses represented an important gate.

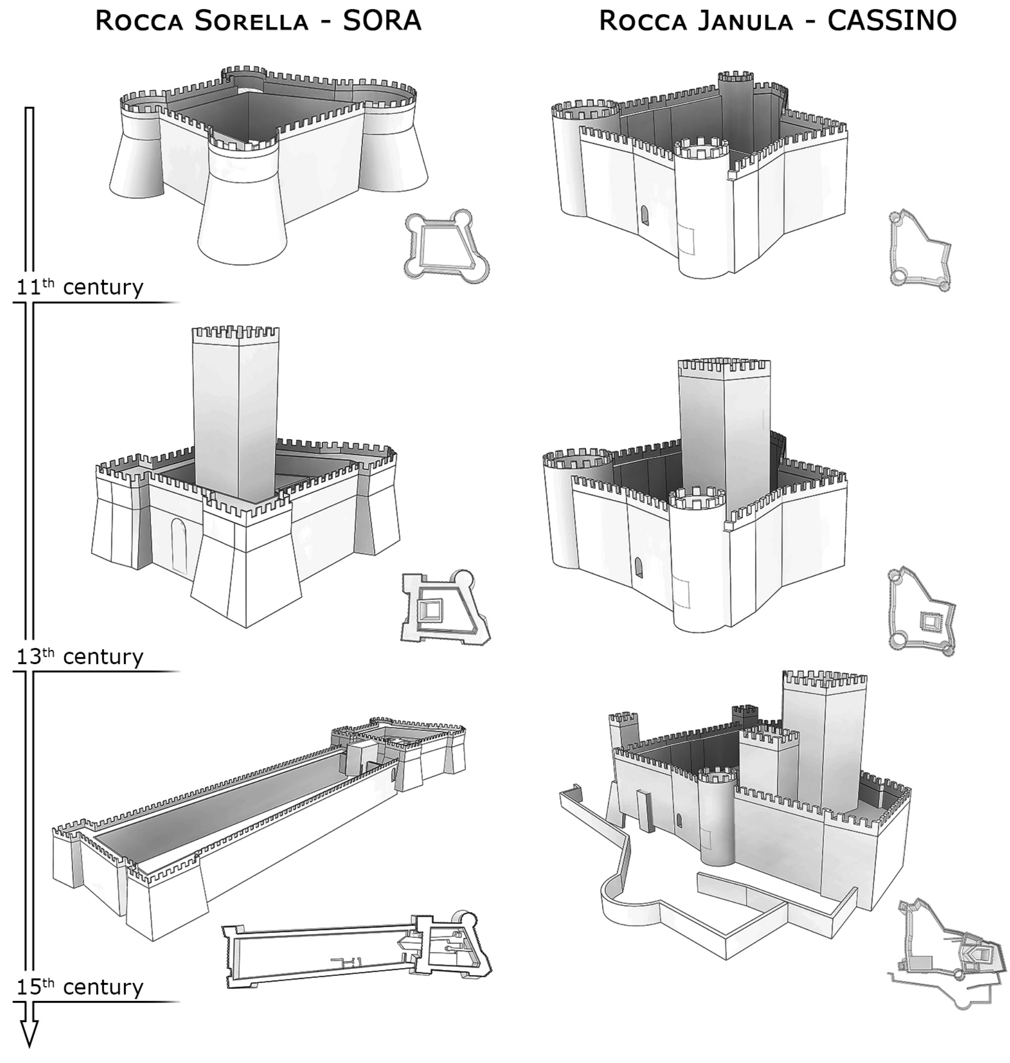


Fig. 06. HBIM elaboration by the authors. The geometrically simplified and monochromatic model describes the main evolutionary phases of the two fortresses. The choice to use the MCM model is dictated by the uncertainty of the historical information and therefore the graphical processing is hypothetical.

In fact, the name Janulo derives from Latin, **iānŭa**, meaning small door, due to the presence of a small passage in the walls of the fortress that guaranteed access to the Abbey. Rocca Sorella was considered an *ingressu regni* because it allowed access to the Kingdom of the Two Sicilies [Rosa 2010, p. 19] b). The violent earthquakes and the numerous destructions following the struggles for the control of the territories had caused enlargements and transformations over time, visible in both architectural nuclei. c) The architectural layout presents a first "early medieval" nucleus and then a subsequent extension with the insertion of a keep in the more or less central area of the original nucleus, built with more regular masonry, and last bastions for the defense against firearms. From the analysis of the written sources, the hypothetical historical evolution of the two fortresses can be divided into three main phases, as shown in figure 06.

The three-dimensional and monochromatic MCM model (fig. 06) aims to transform the linguistic sign (written sources) into a visual sign by synthetically reproducing the narrated object and thus establishing a circumstantial relationship between the narrated reality and the image, according to an intuitive and immediate recognition code [Pelliccio 2020]. If iconographic sources exist, the integration between MCM and historical drawings reduces the abstraction of the model itself, and the communication becomes intermediate between the second and third linguistic levels previously defined (fig. 07).

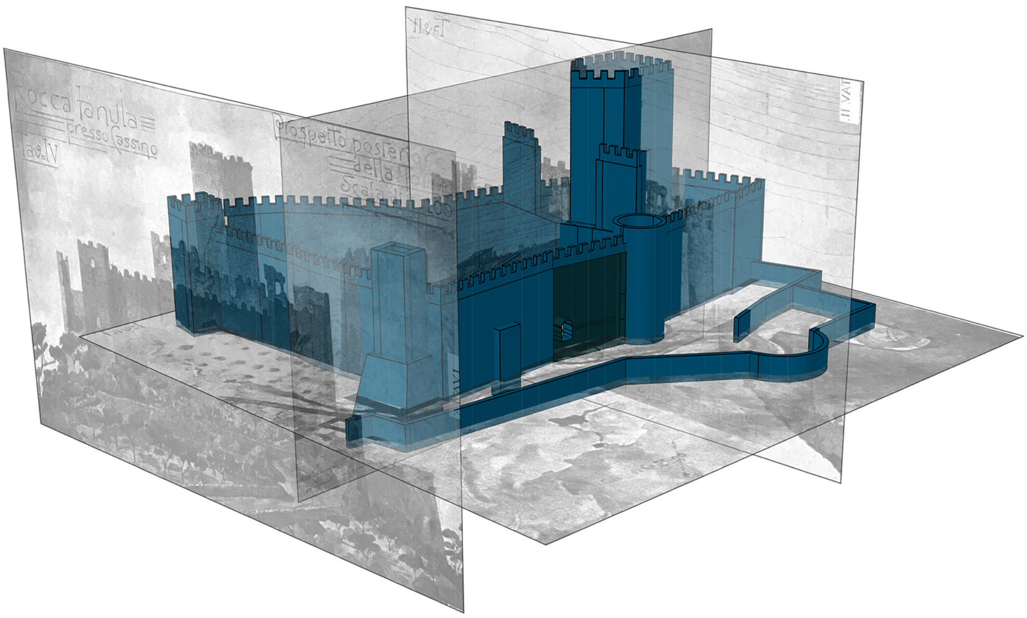


Fig. 07. Elaboration of the authors. The iconographic data (plans and sections of Rocca Janula) were integrated with the MCM model. The communication has an intermediate level between the hypothesis and the certainty of the data.

The Visual/Iconic graphic model (VIM)

The third linguistic level uses the visual/iconic graphic model (VIM), which, like the previous ones, is in any case structured on state of the art acquired with digital survey procedures. In this case, the model with which the texture is associated replicates the real object in its dimensions and its material characteristics.

The photorealistic chromaticity of the images transmits information as a certainty of the data and pushes the observer to a more careful critical analysis (fig. 08).

Furthermore, the VIM takes on particular importance also in the narration of the restoration interventions that have not rigorously applied the reversibility criterion introduced by Cesare Brandi. In this case, the model integrates the mental/clue level with the visual/iconic one.

Various colorimetric choices, such as photorealistic textures for the historically original elements, and compact grey applied to a simplified geometry for the architectural part introduced by the restoration, virtually apply the concept of distinguishability, thus communicating the correctness of the historical data.

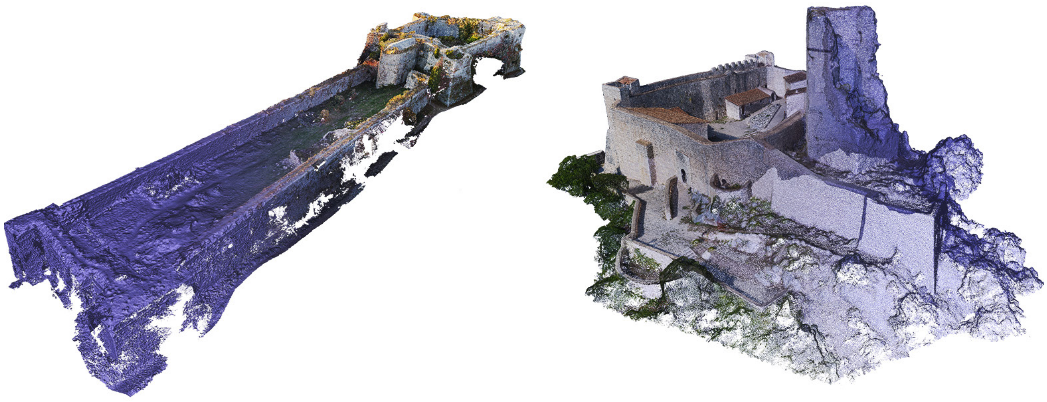


Fig. 08. Elaboration by the authors. The VIM is based on digital photogrammetric surveys with drones performed on both the fortresses (Rocca Sorella-Rocca Janula). The models were textured to communicate the certainty of the data obtained from the digital survey procedures.

Conclusion

The paper develops a procedure that relates the graphic signs with the certainty of historical data. Three different linguistic models, VSM, MCM, and VIM, denotative/metalinguistic, are defined to communicate the complex phenomenon of fortification (*incastellamento*) in the Liri Valley. The symbolic virtual model is developed in a GIS environment and called FortLiri-Gis. It uses graphic symbols to describe a geographically large and complex phenomenon that would be difficult to understand with other visualization systems. The clues mental model focuses on single case studies and uses simplified models in geometry and chromaticity to move the real object from reality to the abstraction to communicate information that does not have data certainty. The iconic visual model uses, for example, suitably structured photogrammetric data. The images, which result from an elaboration of state of the art with photorealism, convey the certainty of information. In future developments, the procedure, applied to the numerous case studies present in the Liri Valley, aims to define an algorithm capable of identifying graphic signs, in terms of geographical, geometric, and material characteristics, common or dissimilar to the single architectures, to analyze the phenomenon in its entirety and complexity.

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To cite this chapter: Pelliccio Assunta, Saccucci Marco, Miele Virginia (2022). The graphic sign for historical narration of architecture. The fortifications of the Liri Valley. In Battini C., Bistagnino E. (a cura di). *Dialoghi. Visioni e visualità. Testimoniare Comunicare Sperimentare. Atti del 43° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Dialogues. Visions and visuality. Witnessing Communicating Experimenting. Proceedings of the 43rd International Conference of Representation Disciplines Teachers.* Milano: FrancoAngeli, pp. 917-925.

 Isbn 9788835141938