

VIRTUAL REALITY IN THE STUDY OF ARCHAEOLOGICAL SITES: A DATA-BASE FOR *FANUM FORTUNAE*

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ABSTRACT:

The use of Virtual Reality is becoming more and more important in archaeological research especially where , more and more often , there is lack of suitable finds . Consequently the philological reconstruction of architectures and/or architectural sites , no longer in existence, is based on the hypotheses of essentially historiographical origin (descriptions in antique treatises , old drawings, historical and modern surveys , epigraphs, toponyms, etc...) and/or on comparative analysis . The construction of geometrical-analytical, photo realistic models of urban systems and/or monumental sites , that can be animated and modified in time , with the advance of knowledge, thanks to the creation of digital files allows the graphic display of the systems above, comparative analysis with documented similar urban sites and above all diffusion on line.

A practical example of some interest is the creation of a data-base concerning the ancient Roman Colony: *Fanum Fortunae* (Fano). The Colony was founded under the aegis of the Emperor Augustus in ca. 27 B. C. at the point at which the consular road *Flaminia* reaches the Adriatic Sea and turns towards *Ariminum* (Rimini) .

It is highly probable that the author of this town planning scheme was the great Vitruvius who, moreover, describes in detail (*De Architectura* , Book V, Chapter 1) the Basilica built by him in *Fanum* , at present not longer visible having been destroyed in ca. 535 A. D , together with a large part of the ancient public area , by the Vitige Goths.

Virtual Reality enables a reconstruction of the area above approximate in some parts, but on the bases of objective results fundamentally reliable.

1. COMPUTER GRAPHICS, PHOTOGRAMMETRY AND ARCHAEOLOGY

The fields of application of Automatic Design (Computer Graphics; C. G.) have considerably expanded since the 1980s , and there is now virtually no discipline or research field that is not using digital images . Utilisation of the computer as a tool for graphic Representation has rapidly taken root not only in Architecture and Town Planning , but recently also in archaeological Research.

One of the most attractive features of C.G. is its ability to create and manipulate complex 3D images and investigate them from any view point without observer limitations.

These images are true 1:1 scale geometrical-analytical models because each point is rigorously marked by spatial coordinates (x, y, z) referred to three pre-established cartesian axes and stored in the computer's memory.

Thus , all automatic drawings can be said to constitute a data-bank containing a wide range of metric and morphological information about a given subject that can continuously be integrated.

Another important feature of digital models, making them highly flexible , is the ease with which they can be modified and corrected (editing) in real time . This is especially useful when knowledge of a site changes over time as new finds are made , resulting in the need for continuous revision of the basic model. This occurs quite frequently, especially where urban sites are concerned. Indeed , archaeological research increasingly relies on aerophotogrammetry (e.g. orthophotomaps, numerical cartography) as well as on

historiographic research (through the study of treatises , ancient drawings and representations , toponymy , epigraphy) and, signally, comparative analysis of similar, but more documented, urban sites.

In particular aerophotogrammetry , supported by sophisticated informatics tools, provides valuable information for the reconstruction of the " *forma urbis* " , especially of its evolution from foundation to subsequent modifications.

Clearly, aerial photography affords an exhaustive view of the individual bodies making up the tissue of urban settlements.

It also evidences the " *signs of time* " , an indelible planimetric record of successive structural overlaps and/or transformations connected with social and political events.

This method allows , for instance, to recognise ancient road layouts and consequently ancient blocks of houses even after heavy restructuring and/or stratification; the perimeter of ancient buildings whose foundations have been reused; and city walls, defensive or otherwise.

In the case of roman cities , the usually regular and orthogonal street plans are still easily identified despite contamination by successive medieval building, which was less rigorous because usually unplanned and connected with unstable political situations, compromise and power games that cannot always be interpreted.

Aerial photography is thus able to show the complex features of ancient settlements, highlighting relationships and connections among the different organisms (empty and solid) that would otherwise be impossible to appreciate from ground level.

Another important element when reconstructing ancient urban sites or parts of them is the identification of the absolute elevation (with respect to sea level) of planimetric areas (e.g. squares, courts, cloisters, roads) and of their height difference



Figure 1. The archaeological map of Fano. Extract of the photographic map.

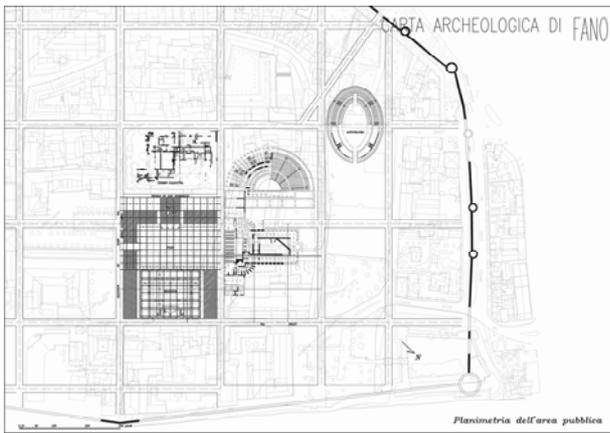


Figure 2. The archaeological map of Fano. The vector representation . Plan of roman public area.



Figure 3 . The archaeological map of Fano. Detail of the photographic map.

from underground architectural entities.

This frequently allows the typological attribution of archaeological ruins lying under the road surface over which different buildings have later been erected using numerical cartography.

This is obtained from aerial survey data rendered as vector representations in 1:500 and 1:200 scales , currently available at most technical offices of the larger Municipalities .

This type of cartography is ideal to draw up “ archaeological maps “ , town planning tools essential for the correct political-administrative and technical management of Italian historical town centres . However , as few Municipalities have draw them up, considerable problems are faced when preparing reclamation, restructuring and/or restoration plans of urban areas . (Figures 1- 4)

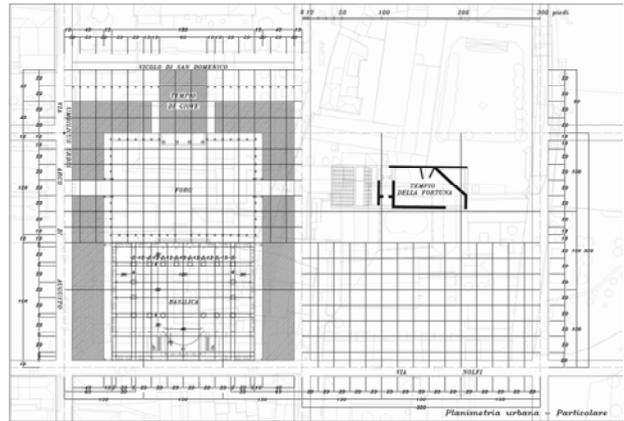


Figure 4. The archaeological map of Fano. The vector representation. Detail of the roman forensic area .

2. 3D MATHEMATICAL MODELS

In practice , numerical cartography allows to obtain 3D mathematical models of the urban-archaeological areas being investigated. It should however be stressed that volumetric reconstruction is the result of a process of careful evaluation of aerial survey data regarding the current state of the surface ; of the information from inspections under the road surface (sewers, underground and/or partially excavated remains, etc.) and, finally, of the correct assessment of the superficial level (s) of the subterranean urban-archaeological tissue.

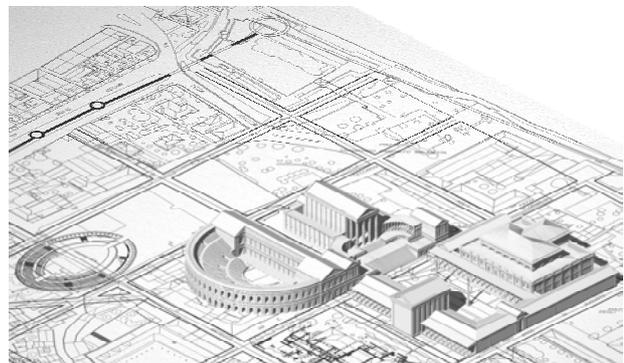


Figure 5. 3D mathematical model of the public area of *Fanum Fortunae* . Spatial view .

In the case of underground entities , their volumetric reconstruction (digital model) is based essentially on objective data , i.e. their planimetry as resulting from excavations , but also on highly probable hypotheses , like their integration with logically connected parts that are still underground , or on previous surveys reporting elements that were excavated and then interred again (as indeed occurred in Fano).

Not less important is the precise estimate of the height difference between the old and new roadways , in addition to indirect information deriving from comparative analysis of contemporary architectural and/or urban typology from other, more documented, archaeological sites.

Among the techniques that can be used to obtain 3D mathematical models , Solid Modelling allows to create , via Boolean additions and subtractions , solid bodies with closed sides; from these , plans, perspectives and sections , besides of course several 3D views , can be automatically extrapolated.

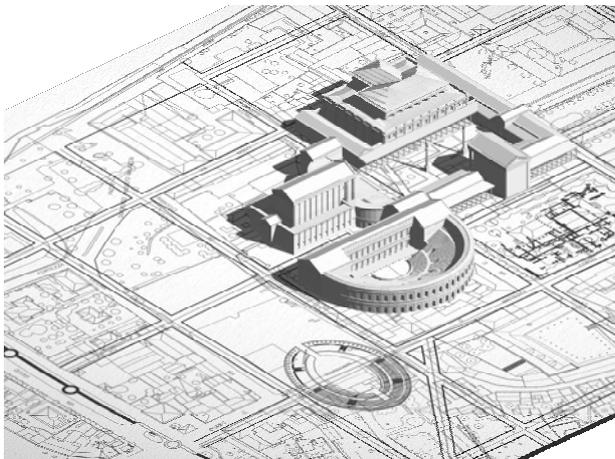


Figure 6. 3D mathematical model of the public area of *Fanum Fortunae*. Spatial view.

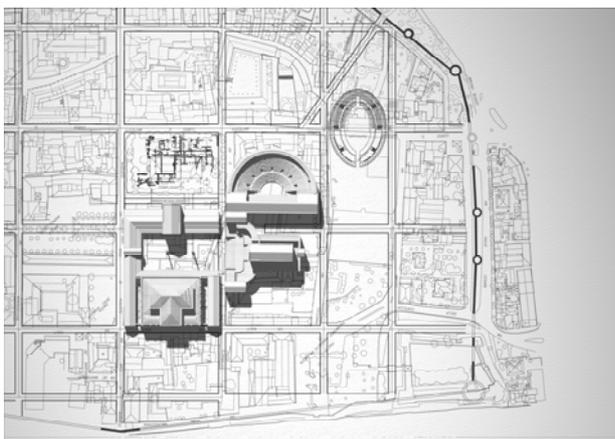


Figure 7. 3D mathematical model of the public area of *Fanum Fortunae*. Plan view.

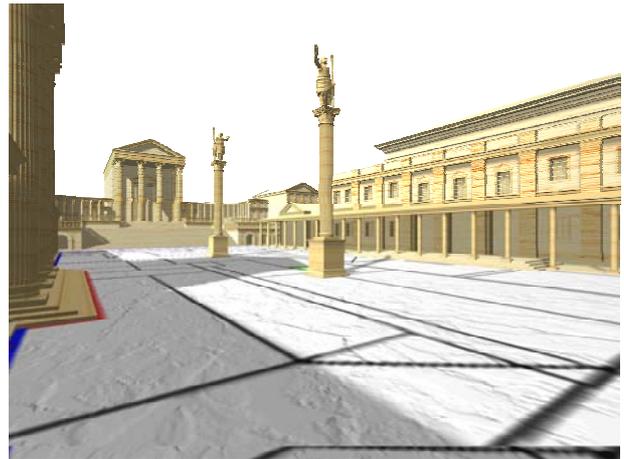


Figure 8. 3D mathematical model . Perspective view of the forensic area. Animation frame.

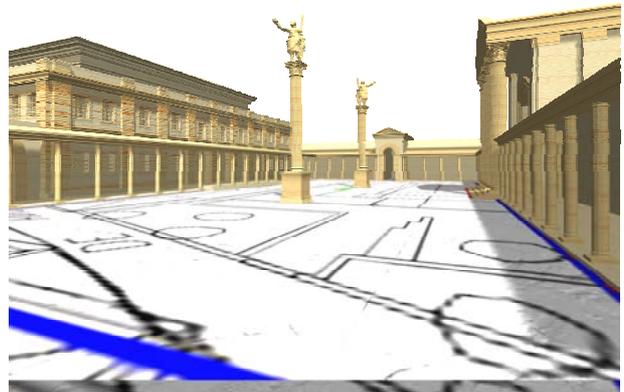


Figure 9. 3D mathematical model. The perspective view of the forensic area. Animation frame.

The information that can be obtained from model exploration using CAD systems is thus abundant.

Geometrical-analytical models are widely used in all research fields , including architectural design, town planning and industrial design and production (CAD/CAM systems).

Where town planning is concerned , the study of historical town centres and archaeological sites crucially requires knowledge of the three-dimensional configuration of the urban tissue and of the spatial distribution of the different building components.

(Figures 5 – 10)

The 3D representations that can be extrapolated from a numerical model provide images of town centres that are quite similar to those that can be obtained by observing a common relief model and walking around it. But the salient feature of digital models lies in their ability to be animated in real time and interactively using new , sophisticated informatics technologies .



Figure 10. 3D mathematical model . The perspective view of the interior of “ Basilica di Vitruvio “. Animation frame.

Indeed , interactive animation allows to live and explore in a virtual manner architectural and/or urban spaces that are still in the design stage, that have been built but are now partially or totally ruined (which is generally the case with archaeological sites), or that have been described but never actually realised. This is easily accomplished by importing a drawing of the model in numerical format into an animation environment and entering the view points and the virtual route. Digital technology thus allows to explore new formal and representational spaces in a way that was impossible with traditional technologies until quite recently.

3. MULTIMEDIA DATA-BASE AND THE MUSEALISATION PROCESS

A drawing is thus no longer viewed as the representation of a specific shape on paper, but as evolving one, directly modifiable from within as the historical and scientific data come in and placed in the virtual dimension of an electronic processor.

It is a sort of multimedia data-base , a powerful container that can interact with the elements filed in it (2D and 3D , vectorial and raster images, sounds, written and spoken texts, animations with special effects, etc..).

Users are free to consult it and have a series of access tools to locate the desired information (hypertext).

Indeed , improved data storing and processing technology has made it so easy to communicate drawings of the cultural heritage , architectural works and historical town centres that the works built or to be built are prevalently conceived in view of their publication on the Internet.

Moreover , the increasing diffusion of the equation : cultural heritage = economic resource is reflected in the recent concept of the “ marketing of culture “ , with attendant increment in cultural advertising and the harnessing of effective communication strategies in the service of the cultural heritage.

Today the discipline of Drawing is increasingly and irreversibly involved in the themes of the “ musealisation process” in its dual meanings of conservation and diffusion of the cultural heritage through the endless possibilities offered by informatics (e.g. virtual representation : photorealistic models and animation , integration by the media) and the Net .

4. CONCLUSIONS

An interesting application is the recent creation of a multimedia data-base on the ancient Roman Colony of *Fanum Fortunae* (present-day Fano , Marche) .

The Colony was founded on the order of emperor Augustus in 27 B. C. where the consular road *Flaminia* reached the Adriatic Sea and turned towards Rimini.

The author of the town plan was probably the great Vitruvius , who describes in detail (*De Architectura*, l. V, c. 1) the Basilica he built there , which was destroyed by the Goths in 535 A.D. together with the majority of the Roman public area . Virtual reality techniques based on objective data have now allowed to reconstruct this area , with some approximation in some parts, but overall reliably. (Figures 11 - 14)

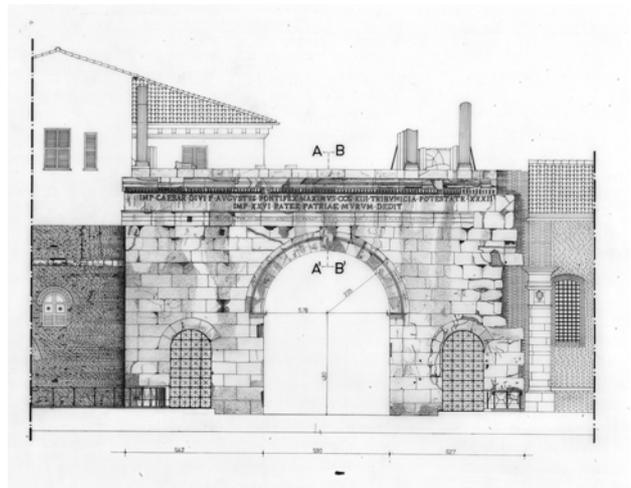


Figure 11. Manual survey of the Gate of *Augustus* in Fano.

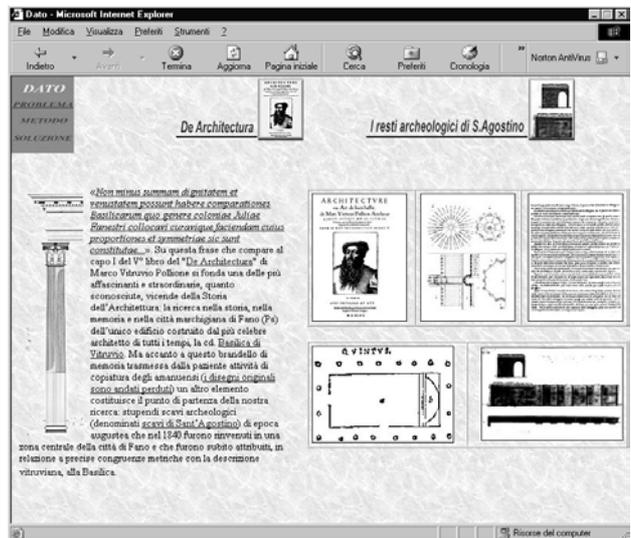


Figure 12. The multimedia data-base of *Fanum Fortunae*. Hypertext.

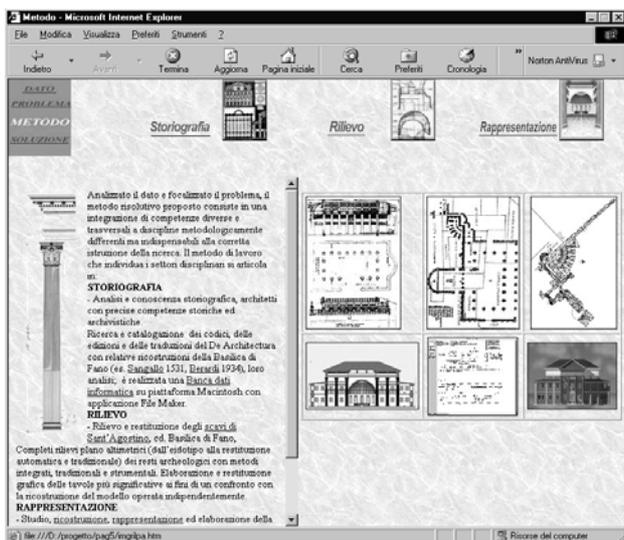


Figure 13. The multimedia data-base of *Fanum Fortunae*. Hypertext.

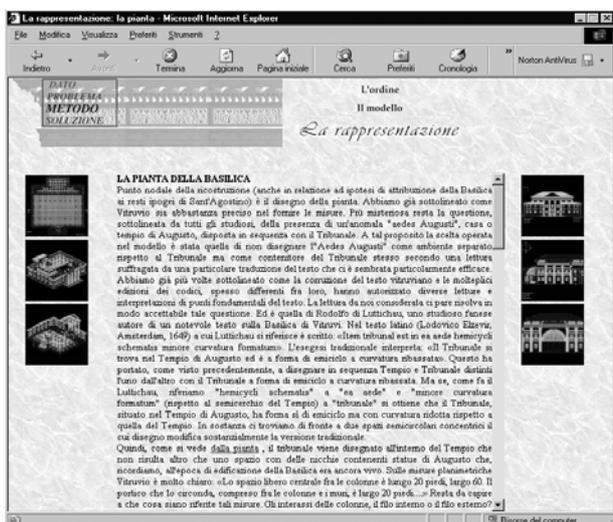


Figure 14. The multimedia data-base of *Fanum Fortunae*. Hypertext.

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