

DIGITAL MEDIA AND ARCHITECTURAL DRAWINGS: A CASE STUDY FROM BRAMANTE

Simone Baldissini*

*Centro Internazionale di Studi di Architettura Andrea Palladio – Vicenza, Italy.

Abstract

This paper describes the experience of disclosure of different design concepts represented in a drawing by Donato Bramante for the construction of the Basilica of San Pietro in Rome using the tools of computer graphics and the digital media. This project was included in the temporary exhibition dedicated to the Architect held at the Palladio Museum, Vicenza, from 9 November 2014 to 8 February 2015.

Keywords

Computer Graphics, Architectural drawing, building history, 3-D reconstruction

1. Donato Bramante and the architectural design art

The recent exhibition held at the Palladio Museum Palladio: *Donato Bramante e l'arte della progettazione*¹ (Vicenza, November 9, 2014 - February 8, 2015) has been an useful opportunity to test the computer graphics to illustrate and communicate to the public the design process of an architect of the Renaissance through an its own design.

The exhibition, curated by Christof Thoenes, in fact revolved mostly around a single drawing developed by Bramante for the new San Pietro commissioned by Pope Giulio II.

For this complex site Bramante prepared numerous drawings, but one known as Uffizi A20 probably exemplifies best of all the complexity of illustration of creative process of the artist, becoming an exceptional source for understanding the project evolution of the *Vatican Basilica*.

2. The drawing

The Uffizi A20², for its peculiarity to represent a layering of ideas and thoughts, has become the base on which many academics are exercised to

trace the early history of the Vatican Basilica since its rediscovery in 1866 by the baron Heinrich von Geymüller (Geymüller, 1868).



Fig. 1: Setting up of the original drawing within the exhibition.

From this time starts the historiographical luck of the projects of San Pietro, specifically of this drawing. At that time the only way to circulate this document was via pioneering *facsimile* obtained through photographic technique and reproduced typographically boards *in folio*.

¹ www.palladiomuseum.org/exhibitions/bramante

² www.uffizi.firenze.it/gdsu/euploos/#/disegni:@00016023

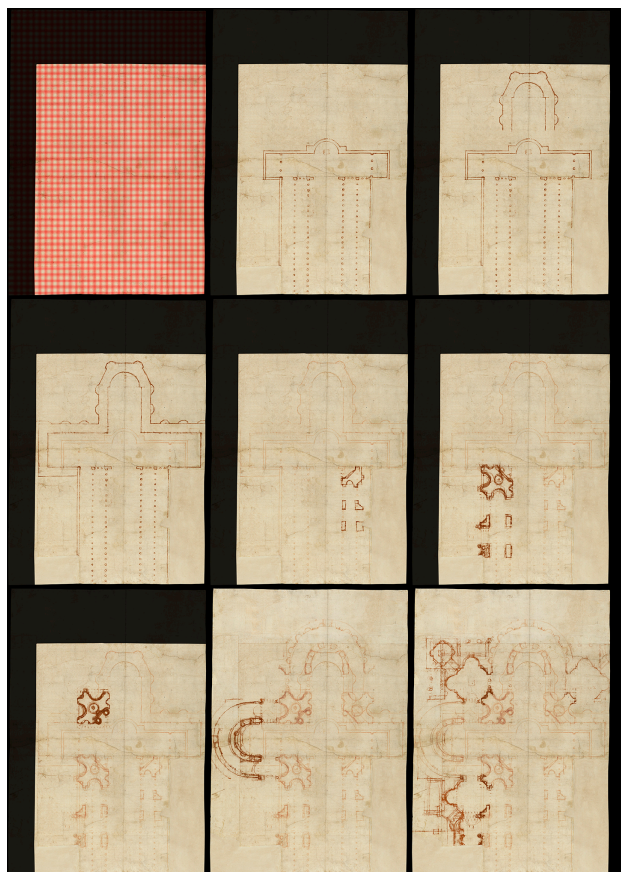


Fig. 2: Identification of the main levels in the drawing.

Overlooking the incredible impact that this discovery and its subsequent dissemination in the academic world had for the development of modern architectural historiography of Bramante and San Pietro, purpose of the work illustrated here is to make available to a wide audience the content expressed inside the drawing.

While a researcher has the ability to read drawings layered one on another, to reconstruct the time sequence, identify reference points, compass holes, etc., the visitor of an exhibition is not able to understand this complexity that at first glance seem like an incomprehensible jumble of traits in *sanguigna* on a stained sheet.

The design looks like a palimpsest composed of different layers in which Bramante added step by step his reflection on the plan of the Vatican Basilica (fig. 2). The UA20 drawing was not made with the intent to be shown to the client and then to demonstrate a solution accomplished, weighted and easily understood through a design fair copy, but it is a worksheet on which Bramante sketches for months their intuitions

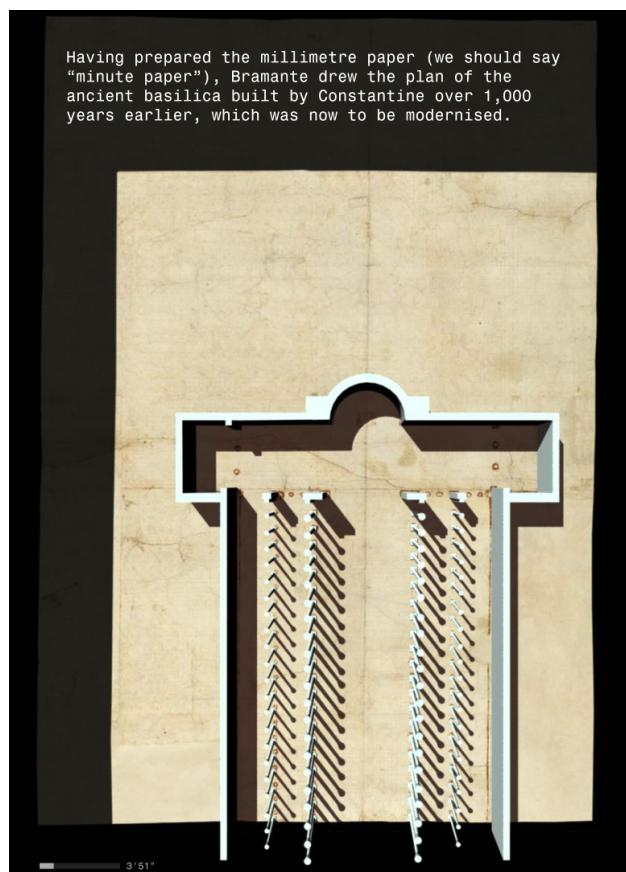


Fig. 3: The drawing cleaned up with only Constantine basilica and its 3D reconstruction.

that would have been developed and refined over more sheets. This overlap of information is on the one hand the historical importance of the document, and the other determines the difficulty of interpretation, especially by non-experts.

3. The reading of the drawing through digital tools

Digital tools could enable you to manipulate the original source and submit it under new points of view with effectiveness previously impossible (Kensek, Swartz Dodd, & Cipolla, 2004). If in the past the reading of the drawing would require the study of several written pages now it is possible to make “talk” directly the drawing so that it is easily understandable to a wide and not specialized audience through visual systems³. The use of the digital technique in this case was not addressed to obtain a copy which is to replace the original, as act as an aid to its understanding.

³ <https://www.youtube.com/watch?v=yZjid7L68T4>

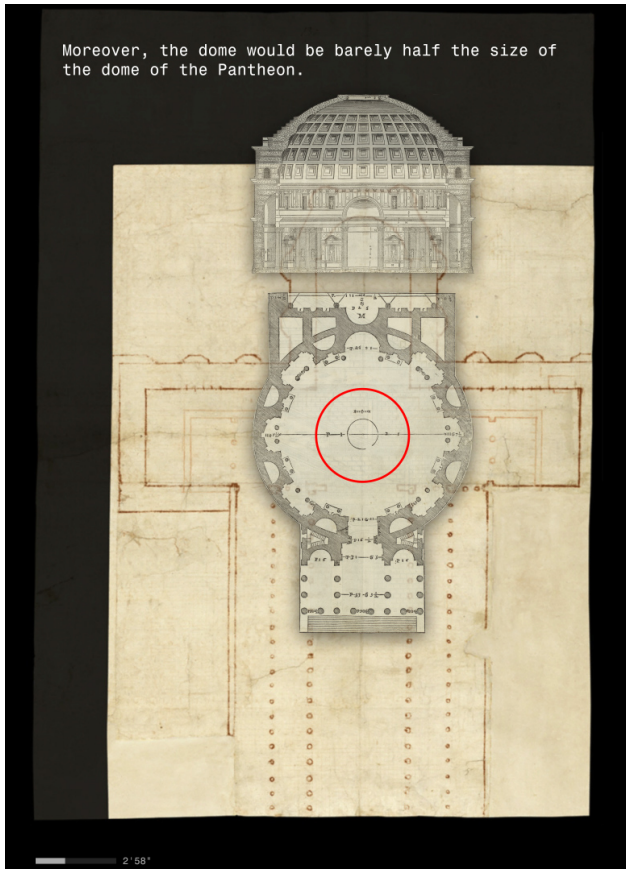


Fig. 4: Comparison between the first solution of the dome with the size of the Pantheon.

In the exhibition, in fact, the original drawing was welcomed in a sort of an “intimate” alcove for the consultation remain the main focus for the visitor, while the digital reproduction served as a “breadcrumb trail” to navigate the various layers represented.

3.1 The difficulties of understanding

There are many problems that you may encounter in the understanding of an architectural drawing (Bakker, Meulenberg & de Rode, 2003). The two-dimensional representation on a reduced scale of a three-dimensional reality constitutes a high degree of abstraction that makes complex the perception of space. The absence of a façade drawn is a further obstacle that forces the viewer to understand the vertical development of the plant. If the problem to reconstruct two-dimensional views in volumes is added to the simultaneous overlay of different solutions (at the same way of modern layer in the CAD software) it is clear that the understanding of the drawing, and especially how it evolved, becomes extremely complex.

3.2 The digital read

For the exhibition was set up a multimedia tool to aid the reading of the design using everyday technology as a simple video projector. The intent was not diverting user attention with interactive stations. There was not even the goal of “discovering” new information up to now not yet been identified by traditional methods. The aim was rather to reconstruct the creative process and make it communicable to the general public through animations which could highlight the various steps, minimizing the use of textual explanation.

This result is obtained by combining several factors: the division and subsequent superimposition of the layers, the addition of graphic signs which could highlight the crucial elements of the various steps, the overlap in scale of elements of comparison, 3D reconstruction of the schematic layout solutions to provide the space and the generated volume (Apollonio & Gaiani & Sun 2013).

First step was to isolate the various overlapping layers through a painstaking task editing, going to “erase” the individual lines until you return to the starting clean sheet (fig. 2). The decomposition of levels was performed under the supervision of the architecture historians Vitale Zanchettin e Guido Beltramini.

From the blank sheet used by Bramante, we have proceeded to add one by one the steps to make the final drawing as we arrived today.

First of all, Bramante had checked the paper with a grid with a step of one minute⁴ (about 3.7 mm in the drawing). One minute in the drawing corresponds to 5 real palms in the building and consequently the scale of representation is about 1: 300. The grid, historically not used so far, is too tenuous to be clearly identifiable on the paper and an video has been underlined in order to be perceived at a glance.

Prepared graph paper Bramante designed the plan of the ancient basilica, built by Constantine and that had to be modernized. The schematic 3D reconstruction highlights that it is a cruciform basilica with five naves, the central one largest both in height and in width (fig. 3) (D’Arcangelo & Della Schiava, 2012).

On the Basilica of Constantine, Bramante engages what is already built of the magnificent choir begun by Rossellino for Pope Nicolò V fifty

⁴ A minute corresponds to 1/60 of Roman palm (22.3 cm).

years before: an unfinished project, with the walls reached a height of only two meters.

After reaching this stage Bramante has completed the survey of the construction site and from this actual state he starts its design.

The first Bramante's selection is to reuse as much as possible the existing structures thus limiting the costs of the construction. Thus he provides for the demolition of the apse and of the old transept and for the completion of the walls of the fifteenth-century choir. Finally he designs a new transept. The nave would remain that of the Basilica of Constantine. This solution could allow the construction of a square crossing with a hemispherical dome at the intersection of the transept and nave.

While the new choir would have wall thickness such as to support the weight and thrust of the dome, it is made clear that on the other side this would be resting on the pillars of the old church, insufficient to sustain the effort.

The dome also would have been just half that of the Pantheon, a symbol with which all the architects of the Renaissance had to face. The overlap in scale between the Pantheon and this drawing makes obvious this difference (fig. 4).

These considerations lead to a radical change of the project. The dome is expanded up to the 45m of the Pantheon pushing on the sides the massive pylons that would have supported. This dilation of the space "deforms" the angular pylon which is cut diagonally and making the passage between the spaces fluid and dynamic and optimizing the walls (fig. 5).

The 3D reconstruction shows the proportional leap from the Constantine solution. Although employment plan will not change substantially, the vertical development is greatly enhanced.

The following steps are based on constant adjustments to this solution. The pylon is further strengthened and at the same time with great carved niches (fig. 6).

Defined the mass of the pillar Bramante articulated even more the space by the introduction of two columns leaning to each pylon and on which the dome would be grafted. This idea is also destined to remain on paper, but Raphael will resume it in the spaces painted for *The Expulsion of Heliodorus from the Temple* in the Apostolic Palace in the Vatican (fig. 7).

Our multimedia application allows, in this case as for the Pantheon, to support and to compare the different sources. Enlarging the size



Fig. 5: The three-dimensional development originated from the first solution with an expanded dome.

of the pillars also involves the enlargement of the aisles and then the final abandonment by the existing Constantine. Reached this stage of his development Bramante realizes that the paper used was too small to hold the entire sole of the new project. For this reason he's forced to extend it by gluing strips of paper to have the space to design the ambulatory. In our application this is demonstrated highlighting the expansion of the sheet. The ambulatories have the same way of curved aisles. For them are drawn different alternatives: by large columns or by section of walls, that are highlighted on the video alternately. Later Bramante completes the outline of the main dome enclosed by other smaller (*quincunx*), surrounding it with four chapels domed. The chapels have the same shape of the central space but a smaller size. The faithful, entering the Basilica, would perceive a continuous change of scale between spaces characterized by the same proportion, but with increasing size. It is a ruse to motivate the viewer to grasp, even emotionally, the great extent of the central dome.



Fig. 6: Three-dimensional development originated by the subsequent solution with pillar strengthened.

To make communicable this aspect were added overlay of graphics that could put in immediate evidence through an animation the similarity of the forms and the dimensional relationship between the parts. Reached this final stage Bramante searches a visual confirmation on the space conceived by him. To do this he uses the perspective to illustrate, in the margins of the sheet still free, the development of space domed.

4. Conclusions

The multimedia realized proved to be a very effective means of communication of the drawing by transmitting a series of information that, in their simplicity, would have been missed by the untrained eye put in front of the palimpsest of the UA20 Bramante's drawing. The idea to grow the 3D model from the plane of the paper was just wanted to emphasize how the plant was generating the spaces also tracing the physical growth of the construction of the building by the addition of various courses of masonry. Despite not having information on the real heights imagined it is possible to deduce them.

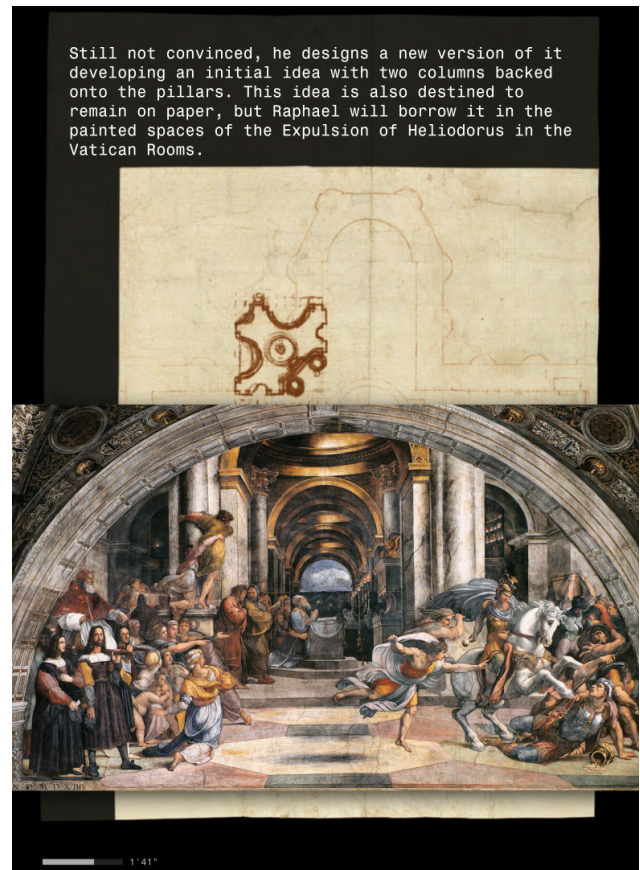


Fig. 7: The comparison between the solution suggested by Bramante and the same painted by Raphael.

In the plan a certain size automatically impose the likely vertical extension. Since the project ideas, sketchy but do not bring to perfect fulfilment, it was legitimate to return them in three-dimensional form using simple volumes without give details with precision profiles of the frames or the type of material. The use of shadows contributes to give depth and make the volume more comprehensible.

In future we will try to add to the application interactive parts allowing customized navigations and detailed in-depth on-demand for different levels of expertise about the topic illustrated.

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