

3D Poitiers evolution

During major renovation works in the downtown, the City of Poitiers (France -Vienna) in partnership with INRAP has launched in March 2013 a virtual and historical app project using Augmented Reality. The main objective is helping the public to discover a city in perpetual motion and show the progressive urban development.

The success of such a project, approved by archaeologists and historians, requires a long preparatory work and a constant dialogue between them and the 3D graphic designers.

Four major periods were defined on a first area for a diachronic approach: Early Empire, Lower Empire, medieval period and modern period.

Besides topographical and digging maps, archaeological operations conducted by INRAP in 2012 and interventions of the archaeologist in charge of the excavations for the City of Poitiers provided an important photographic background with different levels of description.

These choices were mainly motivated by the rupture each period represents respecting the previous one, from the historic point of view but also considering the impact on the appearance of the neighborhood and the city. The amount of available information was then used to set the right period for each restitution.

In order to illustrate the different periods in the best way, the two spots from which the viewer can watch the 3D panoramic were positioned either side of the Lower Empire's enclosure. This is a recurrent architectural element.

3D Poitiers evolution project
City of Poitiers in partnership with Inrap and Drac Poitou-Charentes

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3D Images
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The Early Empire

The Puygareau neighborhood

Two archaeological excavations run by Inrap in 2012 allowed to identify an ancient street lined with porticos and a rich mansion on its south side.



1. Street down to the Clain
2. View towards the crossway and its fountain



250

The Low Empire

The enclosure construction brought a profound change to urban physiognomy. It was accompanied by the dismantling of the monumental center and the deconstruction of the neighborhoods situated on its plot.



3. Construction of the enclosure
4. Wood wheel used to lift materials



300

The Middle Age

Despite the lack of information available for this period, these images give the best idea of the buildings through the archaeological excavations.



5. Backyards and gardens 13th century
6. The building of the house on a cellar discovered during the archaeological excavations of 2012



1250

The Modern Period

Located under the City Hall built at the end of the 19th century, the ancient walls fragments preserved in the medieval buildings, the Gilliers funeral chapel from the 15th century and the Jesuit college, have been the subject of depth studies.



7. The gardens and the chapel of Puygareau's College
8. The facade of the building occupied by the Jesuits in the 17th century

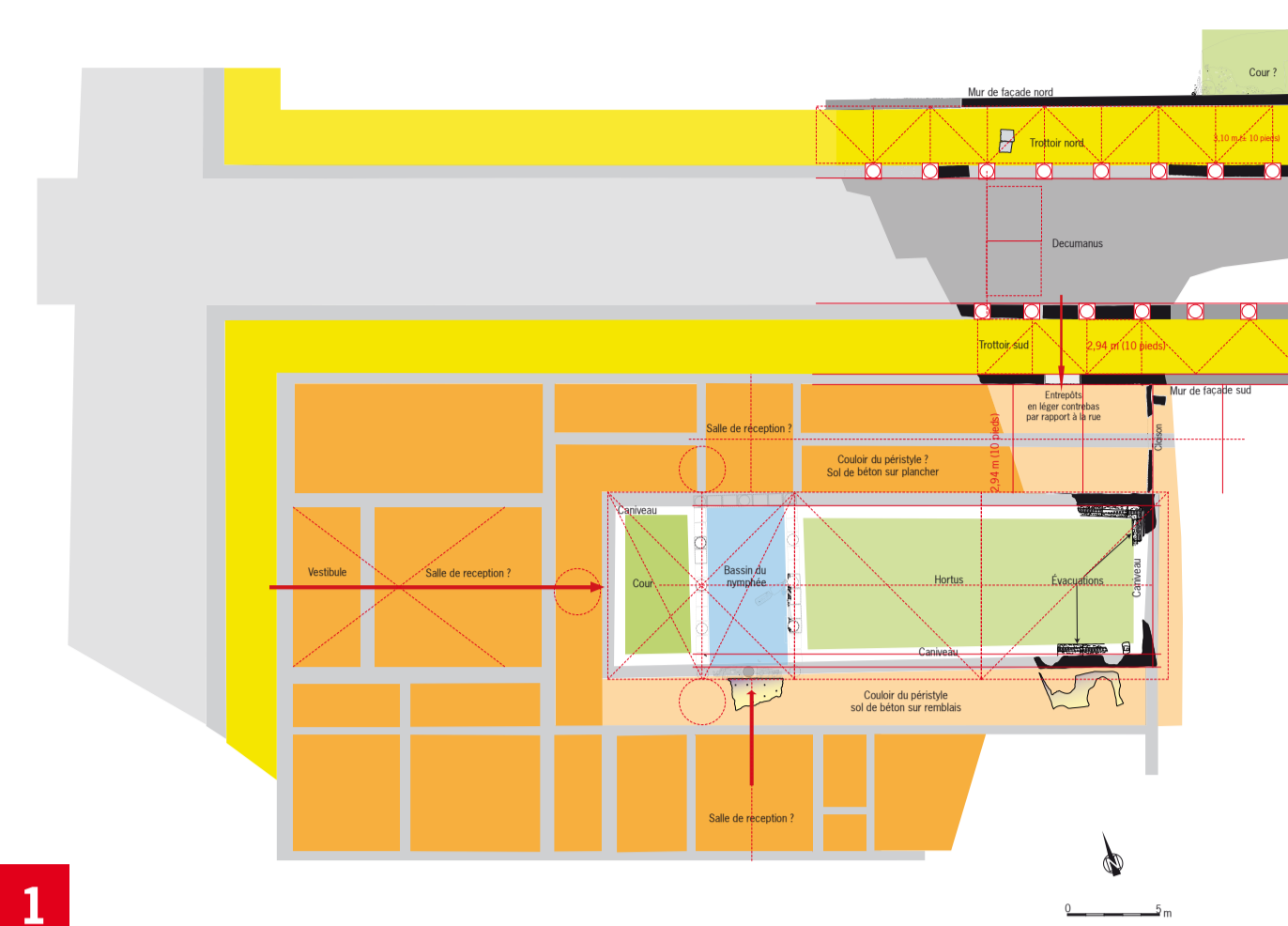


1750

From archaeology...

The Early Empire

The excavation plans allowed an accurate study of the building methods used by the ancient architects. Similarities, as well in the dimensions than in the elements of the lapidary decor enabled comparisons with other digged homes in Poitiers. A first hypothesis of the elevation building method has been proposed and a study model (1/72^e) has been realized. Building materials were determined from: what remains in place (foundation walls, columns); found items in different levels (tiles, stones, lapidary fragments) and from what could be deduced from the material loads (cob elevations, timbered elements above the gantry and a half-buried warehouse). The details of the different elements (windows, doors, public fountain, etc.) have been made based on those stored at Pompeii, Herculaneum or even Poitiers.



1. Research of the layout
Map of archaeological remains and restitution of the space from the building modules. © Véronique Gaston-Brunet, Inrap



3. Ancient roadworks
View of the road in the gardens of Puygarreau. © Frédéric Gerber, Inrap

The Lower Empire

The construction of the ancient enclosure changes significantly the urban physiognomy. It goes with the demolition of the entire monumental area and the deconstruction of the neighborhoods situated on its plot. The suggested image had to offer a view of the finished wall and in the same time to show its morphology. Besides, it had to transcribe the different phases of this gigantic project. The archaeological documentation available focuses on its foundations. In addition, only one partial section has been kept and we had to find other examples of similar enclosures in other cities (Carcassonne, Dax, Evreux, Le Mans, Roma, Trier).



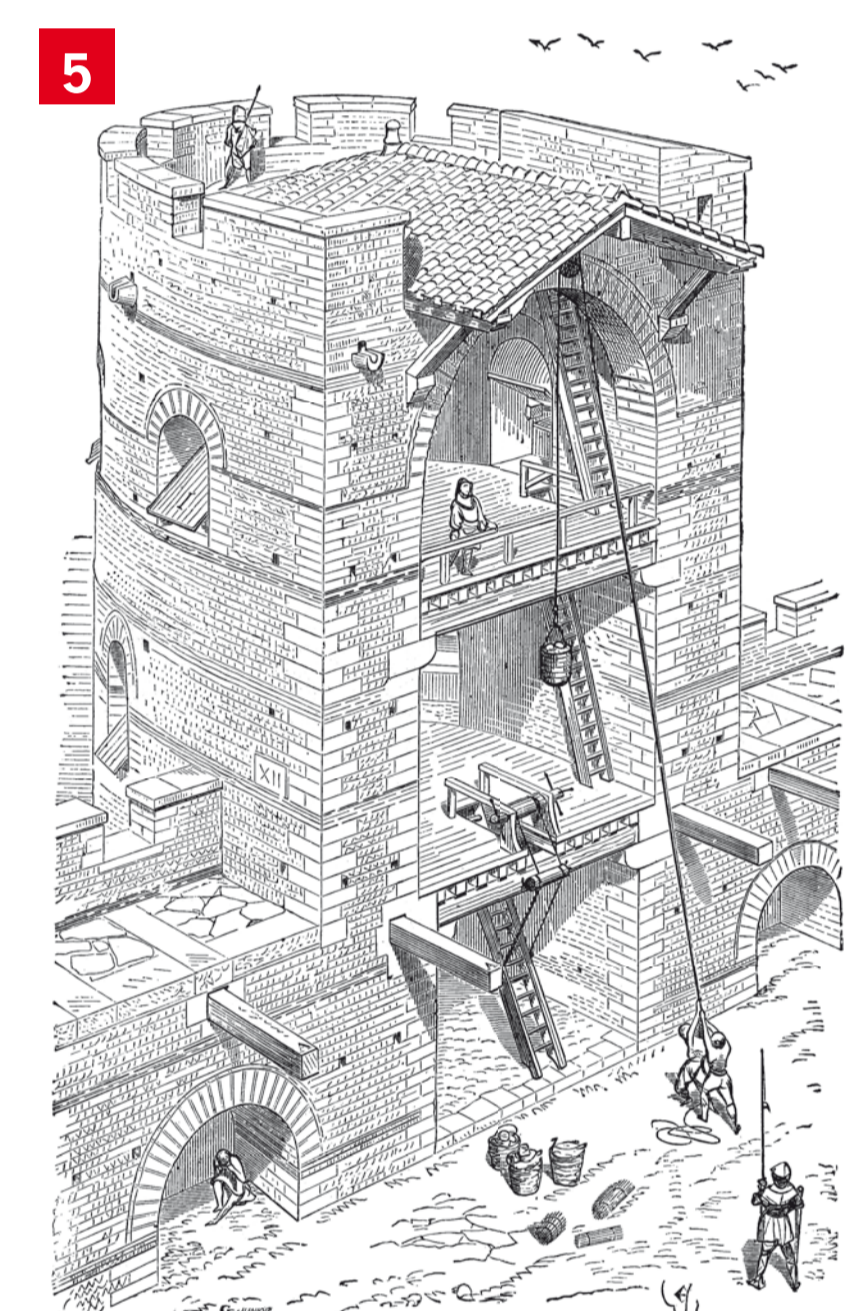
2. Details
An ancient stele from Museum of Augsburg, Germany was used as a model for the oxen' front yokes. © Gilles Habasque

The Middle Age

The scene was placed in the 13th century, at a time when the ancient useless enclosure begins to disappear and is substituted by the medieval walls. A slight temporal compression was performed to this view, the house under construction, the only item from the excavations, was actually built in the 12th century. Representing it completed would have masked the background. Its wooden structure is derived from the appearance of the walls of the cellar that were found on the area and the lack of rubbles in its demolition levels. The few known medieval houses in Poitiers were used as references for the rendering of other buildings. Other elements were taken from houses in Cahors, Cluny, Orleans, etc. Medieval illuminations gave information for the representation of the gardens and the backyards of the houses, in a still very loose built.



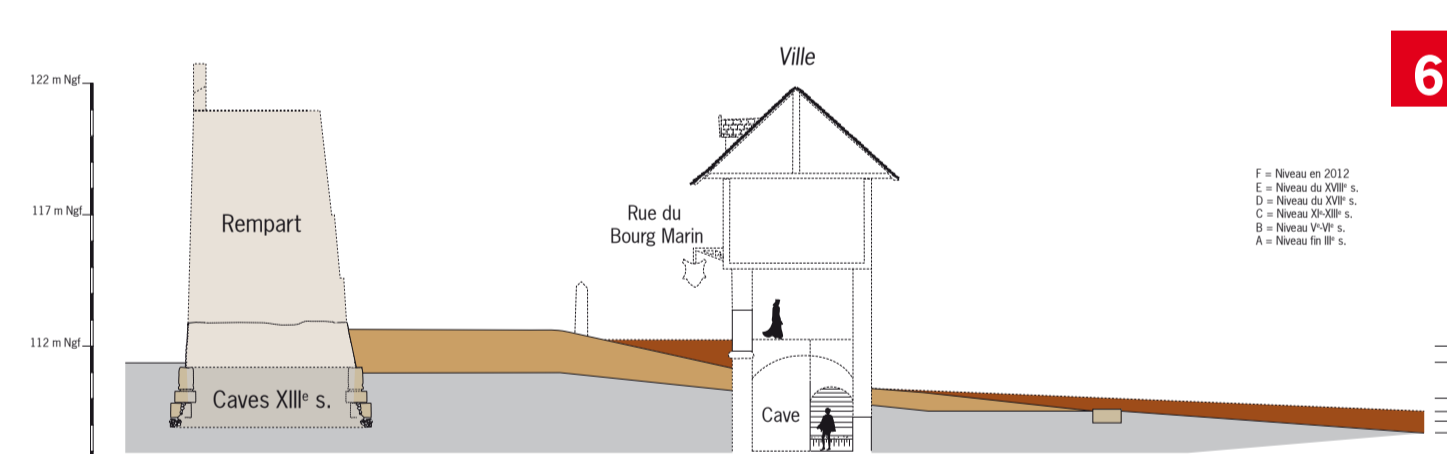
4. The Low Empire enclosure
Its deep bedrocks have been used as stone pit during the Middle Age. © Frédéric Gerber, Inrap



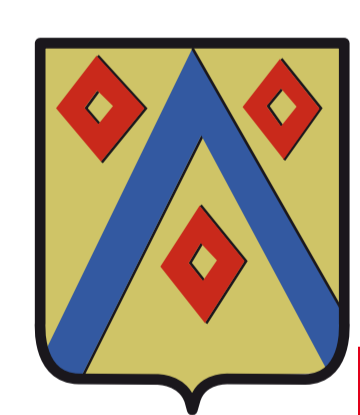
5. The towers
Representation of a hollow tower of the ancient walls of Carcassonne. © from Viollet Le Duc, Encyclopédie médiévale

The Modern Period

It is curiously the period that requested the most important research. There is not any remaining of the mediaval college rebuilt by the Jesuits in the early 17th century. Restitution is based on relatively specific plans made in the 19th century before the construction of the City Hall. Comparison were conducted with the buildings built by this religious at the same period like Lycée Henri IV (former College St. Martha), located next door. The chapel of Puygarreau, built in the 15th century, was only known through texts, a plan of the 19th century and a former daguerreotype showing a general view of Poitiers. The physiognomy of the whole building is inspired by the chapels of the same period kept in the region. We had a thought for the Gilliers' family, which is at the origin of the building, in putting its arms on its gable.



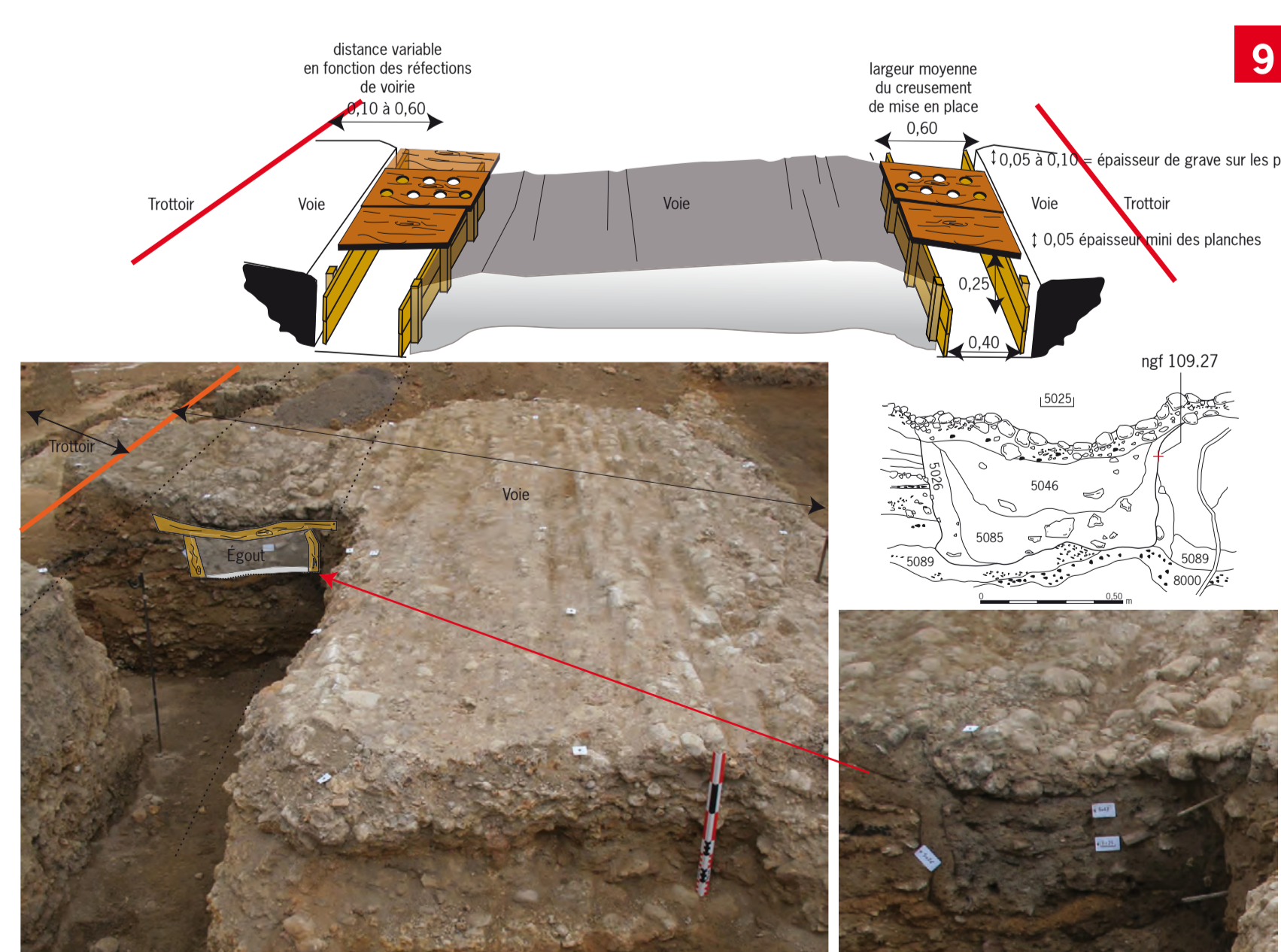
6. Bourg Marin street Middle Age
Sketch showing the redevelopment of this area of the city based on excavation data. © Frédéric Gerber, Inrap



7. Gilliers' arms
Lords of Puygarreau, they built the funeral chapel modeled in the 3D project. © Flavien Bambagioni, Inrap



8. The house on a cellar
View of the downstairs leading to the cellar, found during the excavations of 2012. © Frédéric Gerber, Inrap



9. The ancient sewer
Traces of the ancient sewers under the road. © Frédéric Gerber Inrap



10. St. Martha college
Watercolor of the Jesuit college. © Collection Gaignières, Bnf

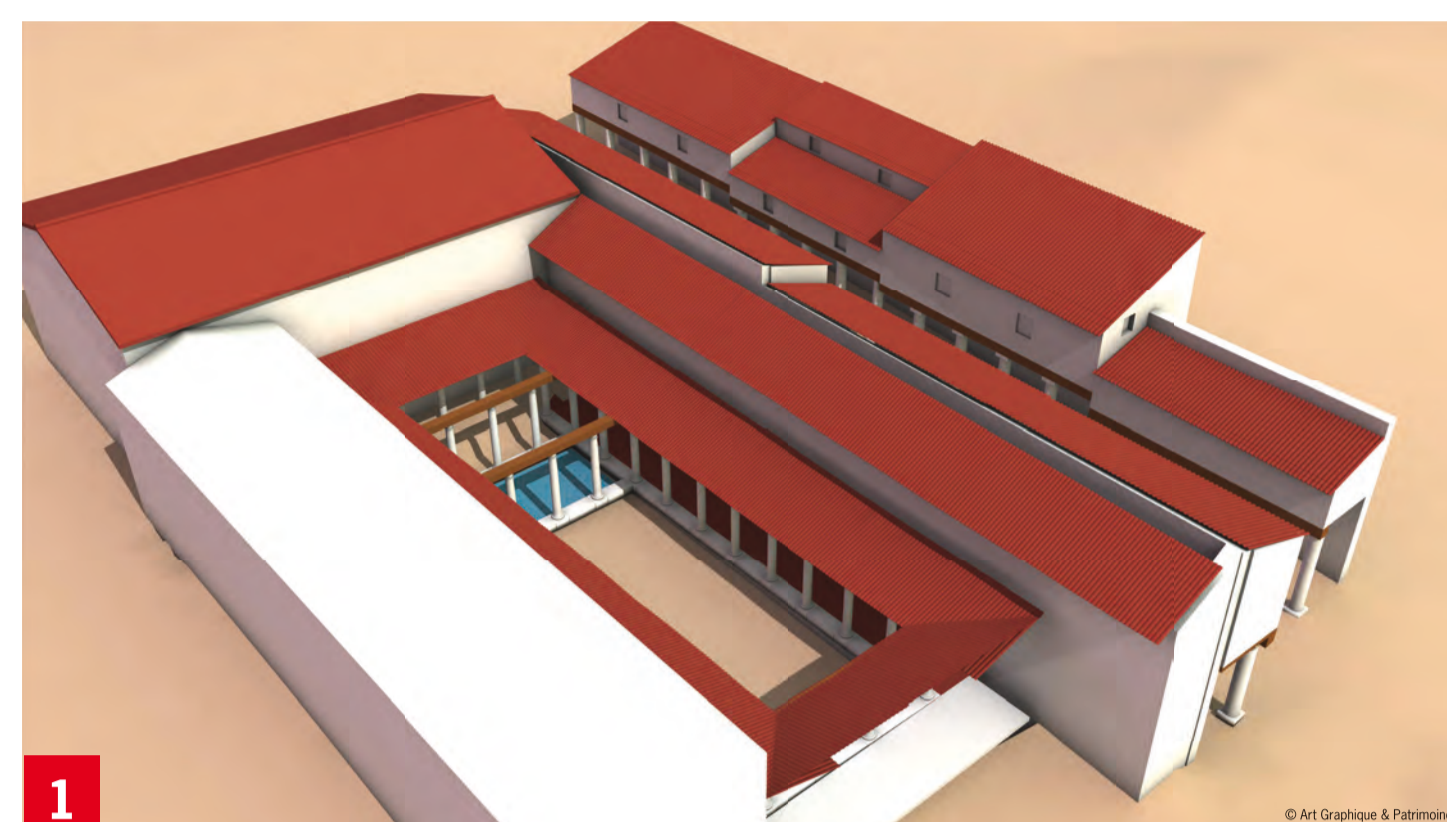


11. The college Puygarreau
Map of the college and the chapel, 19th century. © Departmental Archives of Vienna (D28, n°17)

...to virtual image

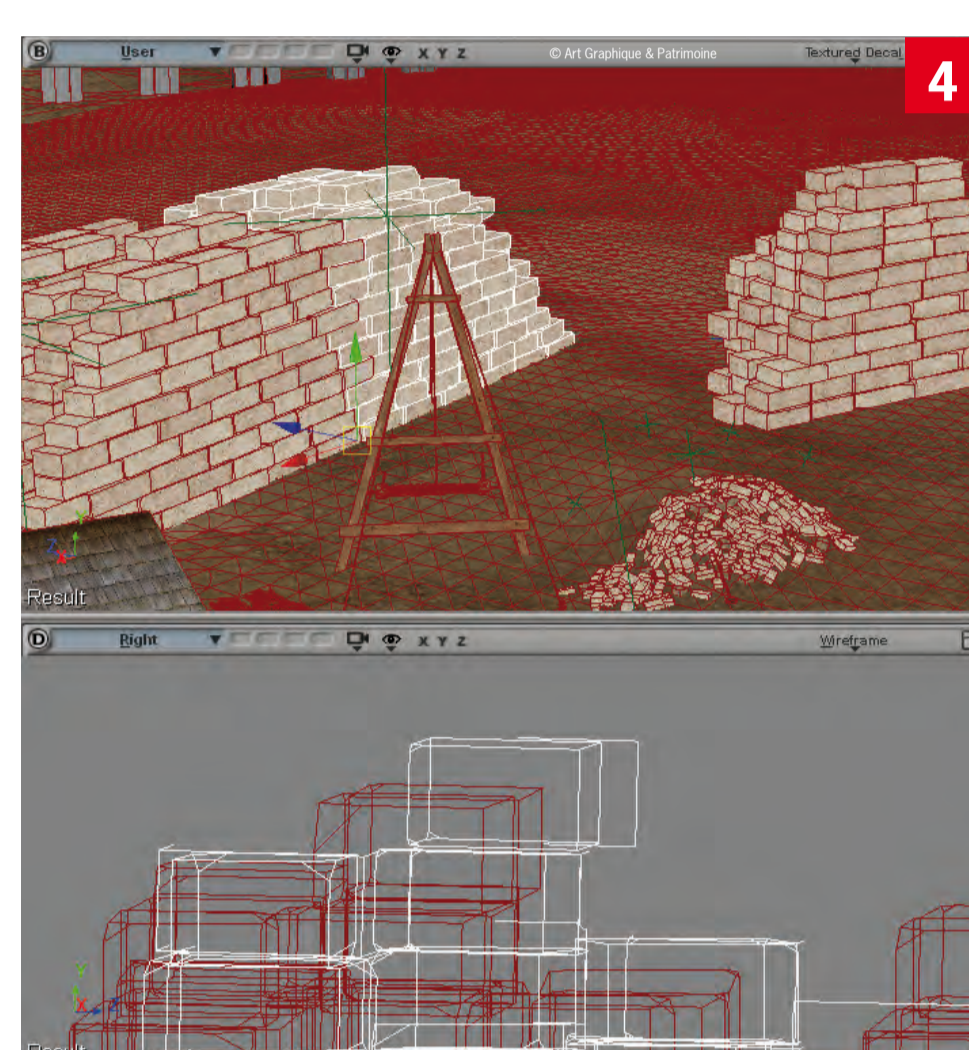
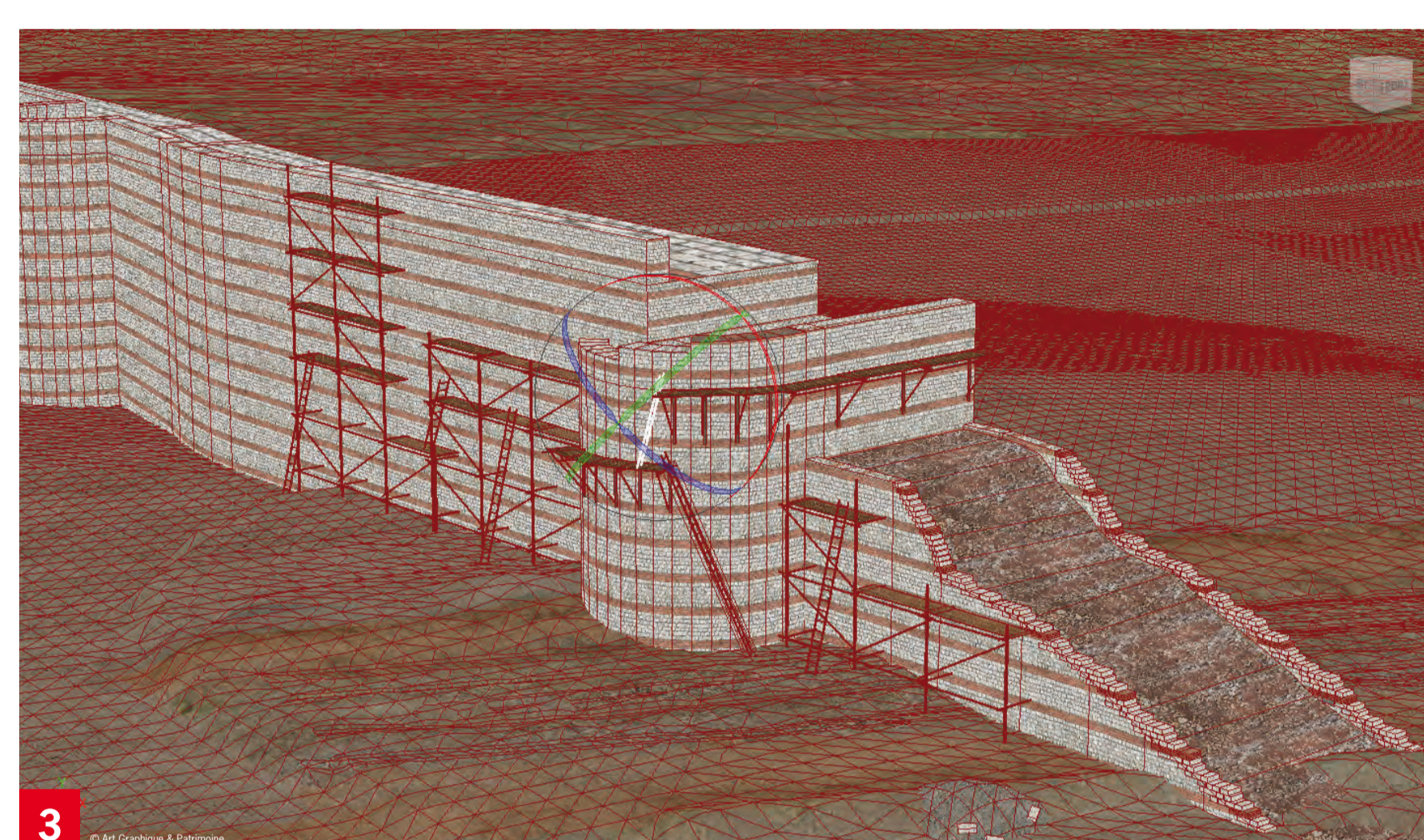
To recover how it used to be (the relevant picture), using what we have (the corrupted image), it is clear that we need to do a restitution effort. We must be able, from what we have (archaeological and documentary indications) to restore what is missing in a way that the image, even if it includes an hypothetical part, becomes a consistent whole, as close as possible to the significant image that the monument had originally. Jean-Jacques Golvin – Cours de Tunis, vol. 1, 2003.

The first digital step involves the reproduction of the ground on which the different restitutions will be implanted. It starts with the preparation and the meshing of the digital elevation model (DEM) possibly corrected with topographic data from archaeologists so it is possible, not only to consider the topography of the restored place but also all that will be visible from it. The remaining work involves four steps, each one validated by the Scientific Committee.



Step 1 : the white renders

For each period, the archaeological and historical plan is integrated to the general DEM. The major buildings are modeled with simple volumes: houses **1** and the columned porticos of the ancient street **2**, the wall construction in the Lower Empire, the houses and the rampart in the 13th century, the Puygarreau college, the medieval chapel and the remains of the antique wall in the 17th century. This work is made using the data provided by the Scientific Committee supplemented by oral information during working meetings and emails exchanges.



Step 2 : the modeling

The volumes of the white render are taken up and the 3D mesh refined: more accurate positioning of walls, additions of windows, doors, chimneys, roofs, etc. For elevations, when they are not known, consistent dimensions are applied to the buildings. It is the same for the details of designs (windows, doors or other) **3**.

The degree of modeling accuracy varies according to the distance of the camera: in the foreground, each element is fully modeled **4**, then on secondary plans, modeling is less accurate or replaced with textures **5**. For remote houses, a block model is created and duplicated with slight modifications in order to give the illusion of diversity.

The scene is finally completed by the closing walls, trees, distant elements, objects. The overall receives a aging effect and some details are refined.

Step 3 : the textures

The achievement of textures is almost concurrent with the previous step. Pictures from a clean database belonging to the graphic designer, or accessible on the internet, are combined with photos taken on site, or provided by the Scientific Committee **6 7**. For example, for worn, damaged coatings, drips and cracks are added. Spaces are reserved for chaining, for arcs on which stone textures will be plated.

For some textures, work is longer and is done by progressive enrichment **8**. Textures must be created with shaded tints and multiple aspects, which allow to vary representations of the same material (stone blocks with different tinges).

Step 4 : atmospheres and image rendering

As there are no landmarks between the reality and the renderings, the camera is positioned thanks to a previous scan performed in situ and to photographs. The general shape of these buildings was included into the modeling. A light corresponding to the location of the sun in the current scene is set, then the mood is set with the rendering software settings (global illumination, radiosity, texture, environment, etc.) **9**.

The image is then computed at 360 degrees. The same image is recalculated with occlusion **10**, then combined with the normal rendering to give it more depth and realism **11**.

The resulting image is finally edited using an image processing software: tone adjusted if necessary, some colors changed, elements vegetation, animals, smoke, etc., added **12**.

