

A PRELIMINARY STUDY OF THE PRAETORIUM OF THE ZENOBIA-HALABIEH CITY

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ABSTRACT: *The Praetorium of the Byzantine City of Zenobia, erected by Emperor Justinian in the 6th century, is an entirely preserved three-level arched construction. Its architect, Isidore of Miletus, who was involved in work on the Hagia Sophie of former Constantinople, created a solid building from the only material available, plaster, whose ashlar mould to the same effect as its mortar and coatings. Solely the vaults, with an interesting Byzantine block, were erected with bricks, which were probably transported on the river Euphrates running through the city, to the construction site. This paper describes the preliminary study of the restoration of this unique building given its antiquity and uniqueness throughout architectural history.*

KEYWORDS: architecture, byzantine, praetorium, plaster, vaults, lifting, justinian, isidore of miletus restoration

1. HISTORICAL APPROACH FROM THE HALABIEH CITY OF THE PRAETORIUM

The Zenobia-Halabieh City is one of the strategic passages of the Euphrates, it controls the traffic of this great river that crosses present-day Eastern Syria, and is a satellite city on the frontier of the Roman Empire, first with Partia, then with Persia. It appears in history in the third century alongside the Queen to whom many attribute its founding and it was named after, Zenobia, Queen of Palmyra, who turned her modest Kingdom, a satellite city of Rome, into a forceful power of the East, capable of confronting its apparent ally with which to fight for territories that extended from Syria to Egypt itself.

With the fall of Zenobia, the Kingdom of Palmyra languished simultaneously when business dealings with the East slumped. It was not until the fifth century that Justinian turned the bank of the Euphrates into a frontier to sustain his dream of a newly reborn Mediterranean Empire. Zenobia-Halabieh was precisely one of those safe holds on which the Emperor concentrated to restructure his defences and convert it into a transcendental link of his orbital network of sites which, around Constantinople, extended from the Danube to North Africa.

This great fortified city is characterised by its jagged city walls. Some walls have been preserved entirely, and once covered one thousand, four hundred metres, had thirty-eight rounded turrets and six gateways. These walls have been subjected to successive repair operations due to crumbling episodes caused by cataclysms and lootings. They consist of an almost triangular enclosure surrounding the hill top that is home to the current fortress which extensively descends to the western bank of the Euphrates.

According to Procopius of Caesarea's testimony, these walls could have exceeded ten metres in height¹, and it is precisely this testimony that witnesses the interest that this place had for the Emperor. This situation led to a series of interventions among which the expansion

of the walls to incorporate the mount that withholds the fortress stands out as the city's defence was in certain danger if a similar domination remained outside the defensive approach taken. It is also worthy of mention how, simultaneously, the top of the river arches itself in the form of a dike which aimed to preserve the walls from strong river currents.

Even though we could describe the characteristics of this militarised city in more detail, which we will do in other articles, it is necessary to concentrate on the city's defensive characteristics now because, within the response to an evident prototype of a Byzantine fortification, we come across an interesting construction located on the fortified line which rises to the mid height of the fortress mount on the northern side of the enclosure; colossal gypsum walls of an almost quadrangular look to withstand water that protrude from the wall in the form of a buttress, flanked by the adjacent barrages: *The Praetorium*.

This large parallelepiped, elevated probably before the Persian threat of 545, consists of a great 3-levelled vaulted structure built to accommodate defending troops, with a surface area of almost six hundred square metres. According to Procopius' testimony, among the responsible persons for most of the constructions undertaken in this Justinian enterprise, we come across architects John of Bizancio and Isidore of Miletus —nephew of the famous architect of the same name and craftsman of the Hagia Sophie who was responsible for repairing the damage that the cathedral suffered years later due to an earthquake that caused its audacious dome to collapse.

The builders of the construction under study created a building that appeared to be made of mountain rock with a view to strengthening the projecting walls. They used huge blocks of gypsum found in surrounding areas which were joined together with mortar and plaster. Only the vaults were made of bricks with the usual Byzantine bonding, and these bricks would have probably been transported via water, having made use of a river connected the production centres.



Figure 1 Overall view of the building with its defence towers.

As indicated, this construction within a strategic location and built to a medium height with projecting cubes on its northern side, and which was protected by the city walls, was built to emphasise not only the flanking of the exterior wall faces, but also the characteristics of a steeped location in response to the superposition of defences and the elimination of visual obstacles, without forgetting the use of resistant materials to ensure strong walls.

In defence terms, the architectural richness of the Halabieh Square not only provides us with a typological model of Byzantine fortification, but also an element of incomparable singularity even in the present-day if we consider its date of construction of this, *the Praetorium*.

In an effort to combine the great achievements of Byzantine urban defensive architecture, we may recognise the important developments that the Byzantines gave the Barbicans: outer walls, walls in the heart of the mountain range (such as the Byzantine Emperors' Palace of former *Constantinople*), and some types of gates built on a bend; a series of contributions, or better still, readaptations of historical defensive models that can be easily identified in Halabieh.

Nevertheless, the wise Byzantine defence decisions not only lie in their architectural investments, but in an appropriate military coordination, above all in the Naval Forces thanks to the creation of an infallible armament, such as Greek fire, that enabled them to clear the supplied naval routes. It was precisely the human weakness factor that brought about the decay of the ample Byzantine defensive network in the presence of the Arabic expansion in the seventh century, when Byzantine gold no longer appeared enough to effectively maintain an army to occupy the various fortifications, or to even pay the loyalty of the ally tribes, in whose hands the control of the Syrian territory had remained.

2. THE PRAETORIUM

The *Praetorium*, this being the centrepiece of this preliminary study, is located in the fortified enclosure of the city and shares one of its exterior walls. Despite the *Praetorium* being in a relatively sound state, and three floors and some of the vaults and domes being fairly well conserved, the immediate surroundings of the building stand in ruins, and can hardly be distinguished in relation to the rest of the ancient city. Only the walls with square turrets that make up the perimeter of the city have a similar degree of conservation. These walls are only interrupted by the passing of the river where the old river port lies. Beyond the walls, the barren desert extends as the freshly watered landscape of the Euphrates grows distant.

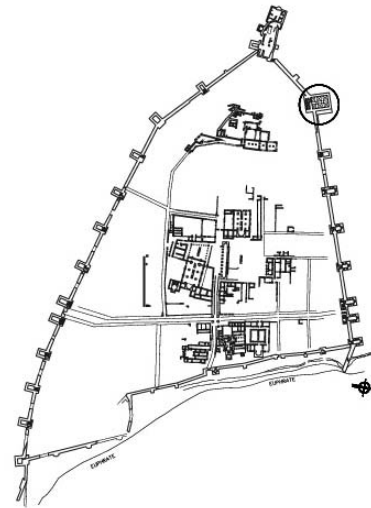


Figure 2 Plan of the area: the building within the walled city of Zenobia-Halabiyeh.

The *Praetorium* in the city of Zenobia-Halabieh is of an approximately parallelepipedic structure. It measures 28 meters long, 16 metres wide, and has an oscillating facade height of 13 and 22 metres. It consists of a 3-levelled structure with a 6-square grid and large structural frames in the middle, as well as a rectangular space located on the entrance stairway. Each square is covered by a partially conserved vault. The exterior perimeter is formed by heavy walls with vaulted niches corresponding to the vaults.

It was constructed with huge blocks of gypsum ashlar with raw plaster between them, and the plaster remaining in some of the corners is of the same kind. The remaining vaults were manufactured in brick, are were also made with mortar and plaster. In some cases, only the pendentives are preserved.

The building presents severe deformations and lesions of varying kinds that we will comment on later in this article, and which are truthfully depicted in the corresponding drawings. In any case, if we consider that we are studying a building constructed in the 5th Century AD, its present state is exceptional, at least in terms of the European standards of that era.

3. THE METHODOLOGY USED FOR THE INVESTIGATION

Data collection was carried out by using both traditional methods and technological means, for example, the theodolite or the optical distance measuring laser combined with the theodolite and tripod. The former system is extremely accurate in measuring coordinates from a distance. The latter offers a precise approach for the deformities of the represented objects. For example, the exact profile of arches and vaults can be traced by means of taking measurements of the joints between arch stones, groin vaults or, possibly, discretionary points on masonry.

The elevations have been raised with the help of calibrated and rectified photographs processed with the same programme, based on support and reference points that have been obtained with the assistance of the theodolite surveyor. These elevations appear in the form of metric lifting which establish a realistic projection from an orthogonal plan since, as we have already observed, the same topological systems used have allowed us to discover the geometrical layout of the masonry and a good number of cracks.

In all cases, the transition between the state of the photomap, that constitutes per se a steeped realistic elevation, and the metric lifting, which was carried out by introducing the



Figure 3 Details inside the gallery.

photomap into a computer-assisted design programme with which we have been able to draw the elevations with great detail and precision.

4. DESCRIPTION OF THE LIFTING

The following have been done: a topographical lifting of the visible arrises of the *Praetorium*; a lifting by means of orthographies of the *Praetorium's* supported ashlar and masonry faces by actual direct measures once the scaffolding had been erected and access to the immediate vicinity was available; an accurate lifting with an optical distance measuring laser adapted with technographs of the interior vaults found in the base of the building which have enabled us to detect deformations and signs of slumping; finally, a lifting of the horizontal deformations and curvatures of the plan of various completed parts of the building.

With the assistance of the theodolite surveyor, a topographical lifting was done of the visible edges of the building. With these means, we were able to determine the spatial coordinates of each ashlar block that makes up the visible edges of the building in such a way that the partial collapsing has been able to be accurately reconstructed in a drawing, as has the *Praetorium's* general slant.

For these purposes, the necessary equipment has been moved to Halabieh, and measures have been taken during an eleven working day campaign to be computer processed and converted into numerical form prior to designing the graphics.

In the corresponding plan, the deformations and inclinations have been magnified ten times more than the horizontal coordinates; in other words, we increased the deformation ten-fold to make it perfectly visible and noticeable at a glance.

Despite the difficulties presented by the size of the *Praetorium's* architectural construction, and the narrowness of the square and the adjacent street, extremely accurate photographs have been taken from as near as possible, from the same square and also from the tops of the neighbouring buildings. With these computer-processed and calibrated photographs, along with the topographical support points obtained at the same time as the measurements of the arrises taken in the previous phase, the photography of the images was rectified by means of a specialised programme: "MSR Rollei Metric."

The captured orthophotographs have been placed on a screen as an electric jigsaw to create the complete elevation of the building. With the photoplans of each building face, a subsequent exact electronic

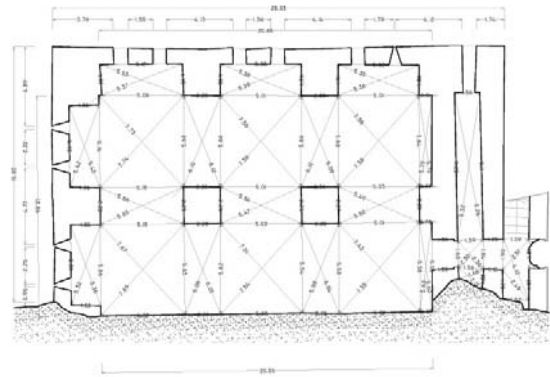


Figure 4 Metric lifting. Ground floor of the building.

replica drawing was produced with the help of a computer drawing programme. The same procedure was followed for the interior elevations of the building.

The use of an optical distance measuring laser combined with a technograph and tripod has enabled us to graphically and precisely estimate the objects in question, particularly with arches and vaults whose deformations could be seen accurately which provide an understanding of the mechanisms affecting the building. In such cases, a larger number of points of the vaults and arches in question have been taken by positioning the topograph vertically and by rotating the optical distance measuring laser. This technique has enabled us to describe the trajectory of the building. This method has also been applied to the existing standing vaults. Likewise, the same method has been applied to mark out the horizontal control point of the base of the building in order to construct the corresponding horizontal sections, thus accurately obtaining the floors on each level.

These manual methods have proved to be of great use as a support method when we compare them with the rest of the technological means used. With these means, we have been able to do, for example, an in situ review and examination of the objects obtained from the building's faces. With the scaffolding in place, we were able to come into contact with these objects. Relevant details have been directly taken from the study of these materials and from the lifting of the pathologies and structural lesions on the building's base by means of either orthophotographs or the optical distance measuring laser.

The manual lifting actually provided descriptions beyond the work processes, this being the case of the systems devised to bundle and curve the arches during the careful deconstruction of the quoins, the subsequent placement of anchor ties, and the in situ soldering of the clock oculus' flat arch structure. These findings were subsequently transferred to the plans by means of a computer programme.

Various complete horizontal exterior sections of the *Praetorium* have been accurately constructed from the base of the operations which was provided by scaffolding platforms. For this purpose, linear rules have been placed closely to each face and we then proceeded to measure the distance between the ruler and the face in question.

With this method, ripples, swellings and recesses of the trajectory have been detected and have proved most interesting, especially in terms of the height of the vaults supports where their thrust on top of the vertical face is greater.

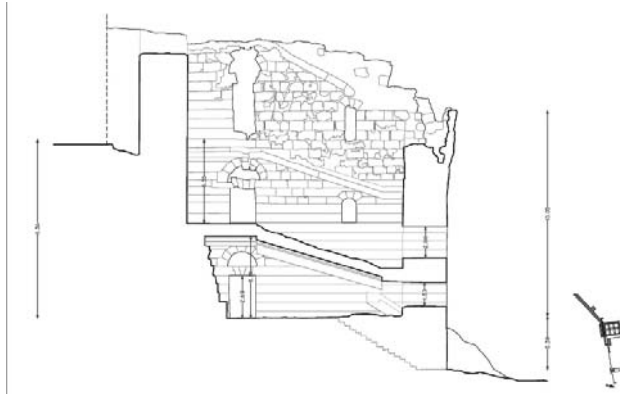


Figure 5 Metric lifting. Example of a cross section.

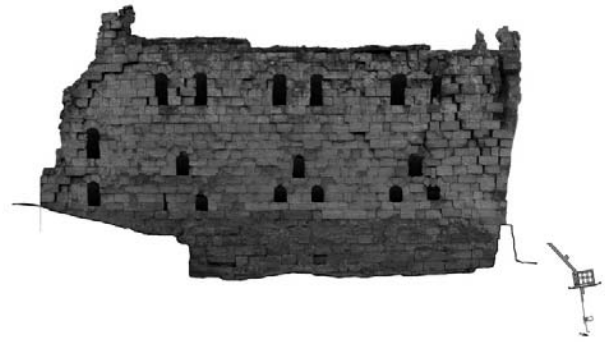


Figure 7 Metric lifting. Example of the photographic rectification. Detail of the east face.

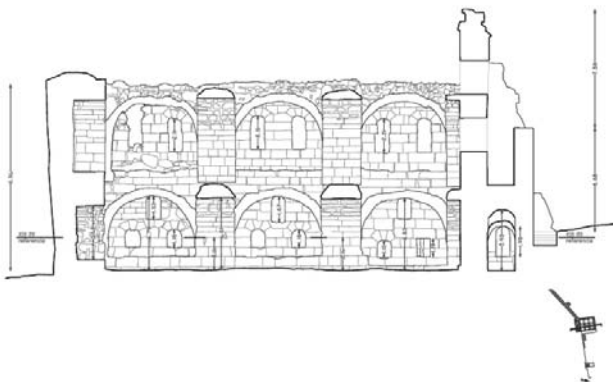


Figure 6 Metric lifting. Example of a longitudinal section where the construction of the buildings is observed.



Figure 8 Analysis of the pathologies affecting the materials. Detail of the south face.

5. A STUDY OF THE MANUFACTURE OF CONSTITUENT MATERIALS

Likewise, samples have been collected to proceed with the remaining preliminary studies in a parallel manner to study the materials that form the Praetorium in order to determine their possible influence on the pathologies that affect it. The Praetorium is fundamentally constructed from a material which is displayed in different known forms: gypsum that forms the quoins in a naturally cut and angled fashion; plaster that comes from the same stone, baked in kilns to create the mortar for joints and plastering; brick is also present in the construction of some of the vaults in the building. Several samples have been taken of the quoins, stones and rocks of the building's surroundings in order to conduct a petrographic analysis in the UPV laboratory.

6. PATHOLOGICAL STUDY

6.1. The Methodology Adapted for the Analysis of the Pathologies.

This study analyses the phenomenon of degradation for the objective of identifying its roots, signs and possible causes. Indeed, a degradation analysis should link the causes and corresponding effects to delimit the degradation field of action and to consequently control the various detected phenomena.

The definition of the deterioration phenomenon is based on the "Normal" lexicon developed by the Central Institute of Restoration in Italy in collaboration with the National Council of Scientific Research. (Normal Recommendations - 1/88, Macroscopic Alterations of Materials made of stone²). A table of the aforementioned phenomena has been drawn up and, in each case, the origin of these occurrences has been investigated.

The visual analysis of these pathologies has been carried out in situ directly in the building, and has been transferred to these pages in a written form. The objective of this analysis was to discover the alterations that should be made, the possibility of acting on the phenomenon or on the causes that lead to it, and the form that this intervention will take along with its degree of intensity.

6.2. The Pathologies in the Praetorium

The degradation phenomena present on the surfaces of the Praetorium owing to either alteration or deterioration can be observed in detail in the corresponding plans.

6.2.1. Stone Degradation.

-The Shrinkage Phenomenon.

Shrinkage phenomena are especially present in the form of surface erosion, deep erosion and exfoliation that affect all the faces to various degrees, ranging from isolated and scattered cases in the northern and eastern elevations to the southern and western elevations.

Deep erosion has affected some of the sandstone quoins which are in direct contact with areas where water builds up, and which have been affected to the point where the stability of the building is threatened. Exfoliation also appears in an isolated manner in the stonework as well as in the gypsum ashlar in those areas which are in immediate contact with water.

The Discontinuity Phenomenon

In most cases, the material loss phenomena found in the Praetorium generally appear without being severely affected. They are normally found in areas exposed to a lot of rainfall and weathering, such as pedestals, cornices, ledges, etc. On the other hand, the fissure and fracture phenomena affecting the stone throughout the building

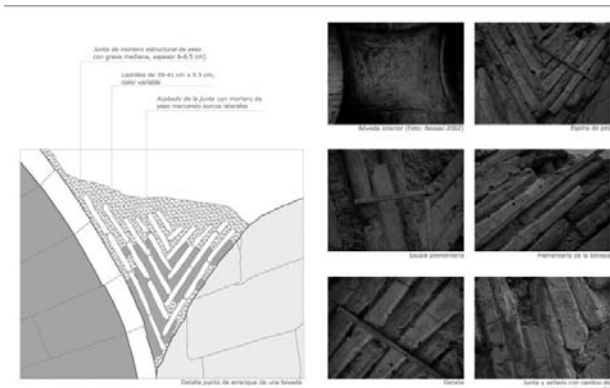


Figure 9 Study of kinds of finishes. Detail of the joints of the vault curtains.

have different causes. In many cases, they are phenomena of a surface fissure kind. On other occasions, erroneous work performed with these stones has caused the same type of fissure although it is not due to the perpendicular layering of the load, but to edge and parallel loadings. At other times, crack displacement and crevices appear around the fractures due to the initial structural lesions that accompany larger sized lesions.

The fractures that appear in the ashlar provide us important information as they permit us to examine the relative displacements between the edges of the lesion which, in any case, have been caused by a considerable force, sufficient enough to break a quoin and, therefore, cannot be ignored. The line of the fractures often forms part of a longer trajectory that has been formed by a lesion running through a substantial part of the building. Material loss is present throughout the whole building, particularly throughout the highly exposed parts.

Deposition Phenomena.

Staining and chromatic alterations have appeared on all the elevations, especially on the interior elevations and on the outer parts of the semi-ruined faces. Their origin is currently unknown as we have not ventured to hypothesise it for the time being.

6.2.2. Brick Degradation.

As a general rule, the bricks that form the vaults, whose dimensions are 40 x 5.5 x 3cm, are well conserved, provided they are conserved in their original position. They have been fired exceptionally and have withstood the test of time.

6.2.3. The Degradation of the Building Joints.

The degradation of building joints may be categorised into two phenomena: erosion and the disappearance of joints. Both are attributed to atmospheric agents, particularly ice and water. Erosion and lack of material in the joints have considerably spread in this building, above all to the upper part of the *Praetorium* where quoins appear to be set without mortar.

6.2.4. Structural Lesions and Figurative Frame.

The evidential structural lesions of the ashlar and stonemasonry, equally distributed on all of the faces of the *Praetorium*, have been the final resource of the restoration project undertaken in this preliminary study. Crevices of alarmingly sizes along the complete trajectory of the building require immediate action.

The figurative framework of the squares is complex and has many causes. Therefore, it has been represented on a large scale with detailed plans of the indications of relative movement that involve all the squares. The general causes of the fissures found in the *Praetorium* are fundamentally the removal and settlement of ashlar, openings due to irregular sedimenting of the foundations, flattening and wall openings caused by the settlement and horizontal pressures of the building's arches and interior vaults. All of these cracks, crevices

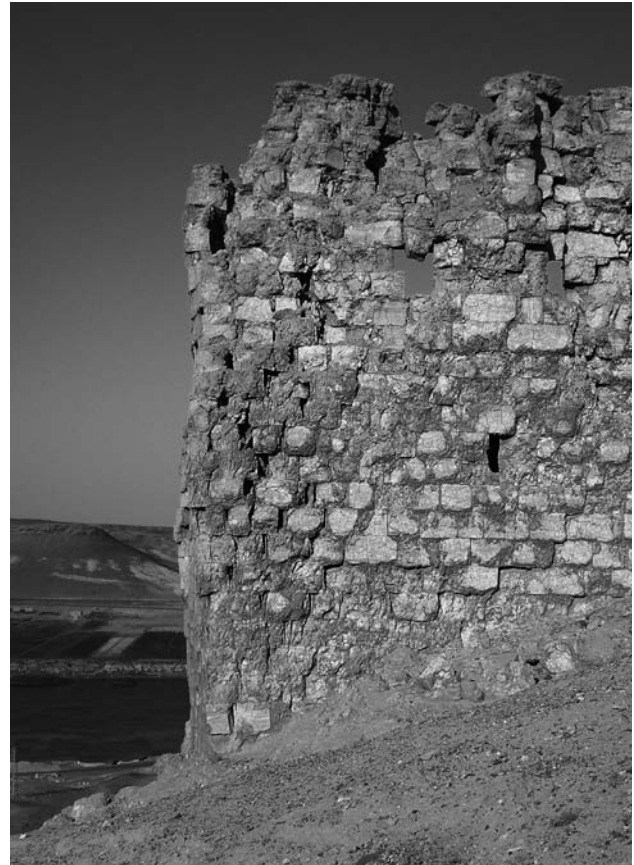


Figure 10 Detail of the east elevation. The city of Zenobia-Halabiyeh in relation to the river Euphrates.

and lesions have been magnified by repeated extreme weather conditions.

6.2.5. Deformations.

One of the lesions in the building that stands out the most can be observed by the unstable states of various arches throughout the *Praetorium*, whose arched stones and surrounding quoins have lost support and have become disjointed, forming successive joints in a state of equilibrium which is becoming increasingly unstable.

The subsidence of the *Praetorium's* faces varies in such a way that the inclinations seen between the contiguous edges cause fissures in the isostatic make up of the masonry. The inclinations noted along the edges are not uniform, firstly because of isolated phenomena such as the likely start of the work, or secondly some isolated occurrences of irregularity or sedimenting within the earth, and the lack of joints in the gypsum ashlar owing to loss of mortar.

The horizontal deformation of the *Praetorium's* faces has been measured with various complete sections of the structure. Certain deformations have been drawn up on the corresponding plan having increased the measurements on the perpendicular plan of the faces ten-fold for them to be clearly seen.

The swelling that the structure's faces depict may well correspond to the disjointing and breakdown of their make up because of lack of mortar combined with the movement of the upper vaults in the enclosure.

7. CONCLUSIONS

The *Praetorium* is a 6th-century building which can be considered exceptionally well conserved despite its ruined state. A good number of its faces have been entirely conserved and its wrought

vaults have been partially conserved. Indeed, its masonry walls have endured the test of time because of the force of gravity and their vertical stance. Most of the vaults have collapsed due to a slow but progressive weathering of the plaster joints and wall deformations, which probably occurred because of earth tremors, foundation sedimenting and/or the movement of the vaults themselves, or even due to a combination of all these factors that has made the vaults lose their stance and finally collapse.

Whatever the case, this exceptional building of an extraordinary well conserved state, at least in relative terms of time, requires structural consolidation and preventive restoration aid for the purpose of ending further progressive deterioration, but without losing the original hallmarks of its rich past which includes the centuries during which it has been unfortunately exposed to weathering.

This type of assistance will require subsequent related studies in addition to this preliminary study, as well as a specific restoration study to detect the most important areas where help is needed and the most suitable consolidation techniques that are compatible with the building to carefully calibrate the following cases: age conservation and the conservation of the ruin's romantic appearance, the building in general and security for visitors, conservation of materials and patina alterations to prevent further progressive deterioration, its descending history and diverse incidents which boast a bright future that will allow other generations to witness this great monument.

For these complementary studies and this restoration project to be written, a new in situ campaign is required to enable all these concepts and theoretic parameters to be considered and to find physical methods, materials and the suitable technology to be genuinely implemented without affecting the aesthetics, construction materials and the history of this monument.

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NOTES

¹ I Procopius of Caesarea: *De Aedificiis, about the buildings of Justinian, book II, VIII, 15-IX, 1, Madrid.*

² AA.VV.: *Raccomandazioni Normal. Alterazioni dei materiali lapidei e trattamenti conservativi Proposte per l'unificazione dei metodi sperimentali di studio e di controllo. Normal 1/88: Alterazioni Macroscopiche dei Materiali Lapidari: Lessico*, CNR and I.C.R Editions, Rome.

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Versión española

TÍTULO: *Estudio previo del pretorio de la ciudad de Zenobia-Halabiyeh*.

RESUMEN: *El pretorio de la ciudad bizantina de Zenobia, erigido por el emperador Justiniano en el siglo VI, es una construcción abovedada de tres alturas que se conserva en toda su complejidad. Su arquitecto, Isidoro de Mileto, que interviene en Santa Sofía de Constantinopla, concibió un sólido edificio a partir del único material disponible, el yeso, que conforma tanto sus sillares como su mortero de agarre y enlucidos. Únicamente las bóvedas, con un interesante aparejo bizantino, están erigidas con ladrillos, seguramente traídos por el río Éufrates que baña la ciudad hasta pie de obra. El texto describe el estudio previo a la restauración de este edificio singular por su antigüedad y único en la historia de la arquitectura.*

PALABRAS CLAVES: *arquitectura, bizantina/o, pretorio, yeso, bóvedas, levantamiento, Justiniano, Isidoro de Mileto, restauración*