



The Acropolis Restoration News

19-20 • February 2023



A 3D model of the Parthenon. Photographs: S. Gesafidis. Construction of the 3D model: D. Mavromati, 2020

V. Eleftheriou - 2019-2020, The progress of the restoration works on the Acropolis

V. Eleftheriou - The new walkways for the visitors of the archaeological site of the Acropolis

K. Skaris, A. Vrouva - The progress of the studies for the north wall of the Parthenon cella

D. Michalopoulou, K. Mamalougas - The restoration of the Athens Acropolis north wall in the area B17 (27,500-35,000)

E. Aggelakopoulou - Research into ancient polychromy on the Parthenon and the Propylaea: the case of the horizontal cornice blocks of the Parthenon

S. Poulou - The codification and metadata of YSMA's audiovisual archive

G. Kehagias - The E/M installations at the Acropolis worksites: corrective, improvement and preventive maintenance

S. Poulou, E. Petropoulou - Digital actions celebrating ESMA's 45th anniversary

E. Petropoulou - The Acropolis News

2020 was the year that marked 45 years of ESMA's work and 20 years since the establishment of YSMA. Although preparations were made for the celebration of this double anniversary and its importance for the modern approach to the restoration of the Acropolis monuments, the pandemic thwarted our plans for a major celebration. After discussing alternative suggestions using the available technology and interesting online applications, some were put into practice, giving as such the opportunity to inform the public about the conducted works on the monuments. The existing infrastructure of the Service also helped with the direct adaptation of its operation to these unique conditions imposed by covid-19, a fact that also allowed it to carry out its administrative work. However, YSMA's operational role is accomplished through the completion of the restoration works, the implementation of studies by marble technicians, craftsmen and conservators. It is thus evident that imposing the necessary measures to ensure the safety of the personnel during the pandemic delayed the progress of the works, since everyone working in the worksites had to do rotational shift work, for a long time. Since strict safety measures were still in effect at the end of 2020, the new and more realistic timetable for the completion of the



The central orthostate of the tympanum of the west Parthenon pediment during the restoration works. Photo V. Manidaki, 2020

restoration works which had to be made was a very demanding task.

Under these conditions, YSMA continued the work that is part of NSRF 2014-2020, submitted proposals to continue the works during the next programming period funded by The Recovery and Resil-



Works of structurally reconstructing a block (Δ.TA.3.3) of the retaining wall of the west Parthenon pediment. Photo K. Skaris, 2020

ience Facility, while at the same time it conducted a series of infrastructure works for the enhancement of the Acropolis archaeological site and the upgrading of the services provided to the visitors.

On the Parthenon, the Technical Office is staffed by the supervisor of the work, architect, R. Christodouloupoulou, the architects, Dr K. Karanasos, Dr L. Lamprinou, V. Manidaki, A. Papandropoulos, K. Skaris, and the civil engineers, A. Vrouva, Dr I. Dourakopoulos and Dr E. Pasiou. The people in charge of the worksite crews were the marble technicians G. Aggelopoulos and S. Kardamis. Three programmes continued on the monument. In regard to the restoration programme of the west pediment the studies completed were: "Structural study for the restoration of the orthostates ΔTY4 and ΔTY5 of the tympanum of the Parthenon's west pediment", "Updating the restoration proposals for restoring the backing wall of the west tympanum based on new data concerning its pathology and the results of structural investigation", "Updating the architectural and structural study-programming of the works for the restoration of the horizontal geison of the

Parthenon west side" and "A study on the interconnection of the west colonnade and the Opisthonaos colonnade in the programme 3DEC".

The above-mentioned studies were applied in order to complete the structural restoration of the three orthostates of the west pediment's tympanum; in addition, one more orthostate was restored in situ. In parallel, 12 dismantled blocks of the backing wall were structurally restored, as well as 16 blocks in situ. After modifying the programme of the west side of the monument, the restoration works expanded on the layer of the horizontal geisa, whose upper surface was revealed after removing the orthostates. Before starting works on repositioning the restored architectural members, at the end of 2020, ESMA re-examined the proposal to fully restore the tympanum of the Parthenon's west pediment. The proposal for full restoration by adding two more orthostates, one which is composed of three ancient fragments, suitably filled, and one completely made of new marble was approved in 2008 (ΥΠΠΟ/ΔΑΑΜ/1922/109812/7.11.2008) and was accepted by most of the participants of the 6th International Meeting for the restoration of the Acropolis monuments.

However, in 2016 a rescuing proposal was approved and so the intervention started in the area. ESMA, looking recently into the progress of this intervention decided to follow the restoration proposal of 2008, and thus the necessary modifications for the continuation of the programme will be made. A crucial parameter affecting the final decision is the structural investigation into whether a complete pediment could be constructed and the conditions that would ensure its adequacy.

The second restoration programme on the Parthenon involves the restoration of the north wall of the cella. The updated study of K. Skaris and A. Vrouva was approved by the majority of the Central Archaeological Council (KAS) in May 2019, no ministerial decree has been issued though. The implementation is carried out according to the initial approval of the study by N. Toganidis that concerns the three lower layers of the wall, updated by ESMA in 2018. Until the end of 2020, the completed works involved the restoration and arrangement of all the blocks of the orthostate, about 80% of the blocks of the first row and ten blocks of the second row. Moreover, the works of carving flutes on the new fillings of

the third from the north column of the Pronaos were completed.

The Parthenon Office, in the effort to improve the practices used in the restoration of the monuments, examined a proposal for "The experimental and theoretical investigation for the study of the mechanical behaviour of the binding elements and materials used on the Acropolis restoration works". The research, divided into distinct parts, started in 2020 in collaboration with Greek universities.

In the spring of 2020, when the archaeological site was closed for the public, the base of the crane constructed in 2011 on the west of the Parthenon was dismantled. The construction, made of reinforced concrete of a total volume about 85cu, from which 55 comprised the volume of the strap and the binding beams, while the rest 30 comprised the volume of the subbase, was removed in parts, by using uninterrupted concrete cutting and pneumatic drills, according to a proposal approved by ESMA in its 12th/13.12.2019 meeting. When moving the crane inside the monument in 2018 and dismantling its base, a large part of the worksite was moved away from the west side of the Parthenon freeing the view to the monument and improving its appearance.



Restoration works on the first row of the north wall of the Parthenon cella. Photo T. Souvlakis, 2020



A view of the Pronaos from the west. We can see the first three from the north columns where the carving of the flutes has been completed. Photo T. Souvlakis, 2020



Dismantling works conducted on the crane base located west of the Parthenon. Photo R. Christodouloupoulou, 2020

The Technical Office of the circuit walls whose head is the civil engineer D. Michalopoulou, employs the architects K. Mamalougas, A. Chatzipapa and Ch. Pinatsi and the civil engineer Dr E. Kakogiannou. The person in charge of the restoration worksite is the marble technician G. Vasdekis.

In the area B17 of the north wall the works completed followed the study of K. Mamalougas and D. Michalopoulou and had to be appropriately modified after removing later additions and discovering the bad conservation state. In 2020, after modifying the Project Fiche, the restoration of the retaining walls in the area of the Mycenaean ascent on the east of the Erechtheion started, because they presented serious degradation problems. The proposal “Consolidation and enhancement of the retaining walls of the Mycenaean ascent” by D. Michalopoulou, Ch. Pinatsi and C. Koutsadelis, includes the dismantling of the upper layers of the walls, the reconstruction of the upper ending of the west retaining wall, consolidation works on the upper level of the east retaining wall and finally local reconstructions using ashlar stones and compatible mortar.

After carrying out a public tender, the consolidation works on the north wall, in the area B14 close to the elevator, where some small stones had fallen and the area was closed for the visitors of the archaeological site, were contracted out. YSMA carried out conservation works on the sur-



Restoration works on the retaining walls in the area of the Mycenaean ascent. Photo Ch. Pinatsi, 2019

face of the same area. In addition, within the context of drawing up “A geotechnical-structural study of the circuit walls of the Athens Acropolis and their rocky substratum on specific areas of direct priority” research was conducted in the area of the rock on which the elevator rested. The intention of the Ephorate of Antiquities of the City of Athens was to replace the old elevator with a modern one that would cater for the needs of all visitors, and so a thorough study of the area was necessary as the loads would increase.

In spring 2020 after the study “Consolidation of the rocky substratum and of the wall built by N. Balanos in the area of

the elevator for people with disabilities on the Acropolis of Athens” had been approved, funded by Onassis Foundation, and supervised by YSMA, the company “Lithodimos” conducted works to reinforce the wall, constructed in the middle of the 1930s by N. Balanos, to support the new elevator. On a surface of around 110 m, a number of 24 passive anchors of a diameter of 25 mm were placed, in a grid of 2,0X2,5 m, out of which 12 had a length of 12 m and were placed in two zones, on the base and on the rock above the wall, and 12 more of a length of 3 m, in the zone considered to occupy an identified geological chasm. Moreover, seven drainage holes were opened, whereas a galvanised mess

was placed on a surface around 18 m² to contain surface pieces of rock.

In June 2019 the following studies were submitted to KAS for approval: “Geotechnical-structural study of the Athens Acropolis circuit walls and of their rocky substratum in areas of urgent priority” and “The strategic plan of the interventions on the Athens Acropolis”. The first one was conducted, after organising a public tender, by the co-operation of the consulting engineering offices of “GEO. PER Consulting Engineers S.A.” and “Domos Consulting Engineers” under the supervision of D. Michalopoulou and N. Ninis and the monitoring subcommittee composed by the President M. Korres and ESMA’s members M. Chronopoulos and P. Kouphopoulos. The second one was conducted by the Technical Office of the circuit walls (D. Michalopoulou, C. Koutsadelis, Ch. Pinatsi, E. Kakogiannou and A. Chatzipapa) and the Office and Laboratory of surface conservation (E. Aggelakopoulou, E. Ksinopoulou and A. Tsimereki). These two studies define the context of the principles and methodology for the future interventions on the Acropolis walls.

While the above studies were being discussed and waited approval the “Study for the restoration of the east wall and the southeast corner of the Acropolis wall” was conducted by Ch. Pinatsi, E. Kakogiannou and C. Koutsadelis. The instrumental observation through a network of 11 accelerometers, supported by the Geodynamic Institute of the National Observatory of Athens and a system of optical fibers, placed by the company OSMOS Hellas on the foundation of the west wall of the Propylaia north wing earlier, continued throughout the period 2019-2020.

Conservation works on the surfaces of the monuments continued on the Parthenon, the Propylaia and the Walls, while small scale systematic conservation works were conducted on the poros architectural members that had been delivered to the Office of Scattered architectural members. The supervisor of the Office and Laboratory of surface conservation is the chemical

engineer, Dr E. Aggelakopoulou.

On the Parthenon, under the supervision of the conservator A. Panou, the conservation of the orthostates of the west tympanum was completed, while the conservation of the horizontal geison was half-completed. Fourteen blocks from the geison have been conserved while four remain to be done. Works regarding the filling of gaps on the lower layer were completed on the backing wall of the pediment together with conservation works on 12 dismantled blocks and blocks in situ and conservation of 12 blocks form the second row of the north wall of the cella.

On the Wall, under the supervision of the conservator A. Tsimereki, systematic in-

terventions were carried out on ten blocks of the interior side in the area B14 and on three blocks in the area B12. Unfortunately, the delay in the completion of the restoration works in the area B17 obstructed the timely beginning of the conservation works that will be completed in 2021.

On the Propylaia, under the supervision of the conservator K. Frantzikinaki, conservation works of thirty-nine architectural members of the north face of the portal wall of the Pinakothek were completed, which covers 50% of the total of the programmed work.

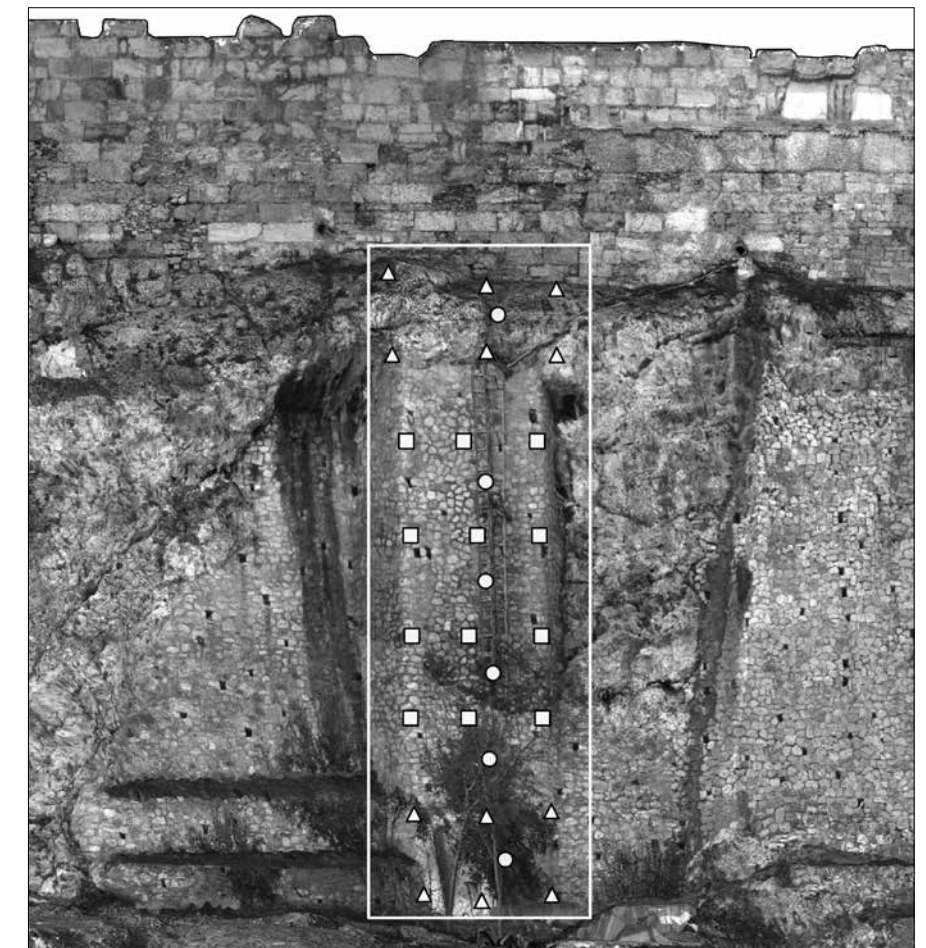
Under the scientific guidance of the Office and Laboratory of surface conservation the study regarding the laboratory evalua-



Placing a new block on the area B17 of the north wall. Photo K. Mamalougas, 2019



Consolidation and conservation works on the north wall, in the area of the elevator. Photo K. Mamalougas, 2019



Orthophotomosaic of the wall and the rocky substratum in the area of the elevator, on which the methods of anchoring the wall are indicated.

△ Passive anchors of a length of 12 m. □ Passive anchors of a length of 3 m. ○ Drainage holes
Photos: Up2Metric IKE. Processing and production of model: S. Kyparissi.
Acropolis Restoration Service, 2019

tion of restoration mortars for the Acropolis monuments continued; investigations were carried out, firstly, into the existing international and Greek bibliography regarding the use of artificial stone in works of monument restoration, secondly, into finding the right materials for laying the visitors walkways by testing a pilot casting of a reinforced concrete mixture in order to fill the gaps in the Acropolis walkways, and thirdly a pilot implementation of consolidation materials on the wall. The chemical engineer of the Office, Dr E. Ksinopoulou, had an active participation in all the above research activities.

Works regarding the recording, inventorying and classifying the scattered architectural members on the Acropolis area, under the supervision of the Head of the Office, archaeologist Dr E. Sioumpara and the archaeologist Dr A. Livieratou, focused on the area of the Chalkotheke,

where 105 members in total were removed as part of the work concerning the final arrangement of architectural members that had remained in that area since the time of the great excavation of the 19th century.

In detail, 27 pedestals were moved from the area of the Chalkotheke to the area east from the Erechtheion to be studied and classified, while 15 bases of inscribed stelae were returned to the area of the Chalkotheke in order to exhibit them in the area where they had originated. Twenty-one parts of columns were removed from the south area of the Chalkotheke to a place where scattered parts of columns are gathered, at the east of the Propylaia. Record sheets were filled for all the repositioned members. In addition, five architectural members that belong to the Parthenon and 31 scattered members were removed from the area of

the Chalkotheke. Six unknown inscribed stones were discovered and delivered to the Ephorate of Antiquities.

After studying about 250 blocks in the area of the Chalkotheke two morphologically unique categories of scattered members were identified. The first one includes 31 simple rectangular bases with one large rectangular mortise for the support of inscribed stelae, while the second one, whose studying is still in progress, includes pedestals of votive offerings presenting many morphological sub-categories.

Other works conducted by the Office of recording, inventorying and classifying of scattered architectural members concern the transfer of a total of 934 scattered members –work that had to be carried out before the beginning of the installation works for the new elevator and the construction of new walkways

for the visitors of the Acropolis archaeological site. These were found on both sides of the pathway leading to the elevator (577 inside a cistern) and were moved southern to the area of the Pandroseion on the south of the Arrephorion. Finally, 29 architectural members were surveyed and 3 scattered members were adhered.

The Technical Office of electromechanical (E/M) support of the monument's worksites, with the mechanical engineer-museologist G. Kehagias in charge, effectively supported the operation of YSMA's worksites, coordinating not only maintenance and repair works of the existing mechanical and electrical equipment, but also the provision of supplies and the installation of new equipment, waste disposal and fuel supply. Another study is investigating the possibility of getting railway material from the Hellenic Train Organisation to modernise the rails of the elevator crane of the SE corner. Other works involved the collaboration with the Ephorate of Antiquities of the City of Athens to enhance the archaeological site (installing the elevator, lighting the monuments, and constructing walkways), to improve the lightning protection system and upgrade the electrical installation of individual positions of the network infrastructure.

YSMA's Documentation Office during the years 2019-2020 employed permanent personnel, its head was the archaeologist Dr E. Lempidaki, the archaeologists E. Karakitsou and E. Petropoulou, the painter D. Hamopoulou and the computer scientist G. Alexopoulos. In addition, the archaeologists Dr C. Koutsadelis, Dr D. Andrikou and S. Poulou, the librarian M. Maznoki and the computer scientist D. Iliopoulou assisted the works related to NSRF 2014-2020. Works that continued regarded documentation and document management, the entry of documentation material from the Parthenon restoration in a database and the update of the database of the AutoCAD files. The library continued to be enriched with new documents (books, reports, studies and work logs), and new content was added to YSMA's library catalogue Open-



View of the area of the Chalkotheke from the western side of the Parthenon. Photo T. Souvlakis, 2022

ABEKT. Other completed works included the digitisation of YSMA's audiovisual archive, a total of 250 hours, its codification and the customisation of the metadata schema in order to start adding them to a database.

A collaboration with the Acropolis Museum resulted in the hosting of the exhibition "Chisel and Memory" in the temporary exhibition gallery of the Museum; the exhibition is extensively presented in the "Acropolis News".

The event entitled "45 years ESMA, 45 years works" was organised and implemented by the archaeologists S. Poulou and E. Petropoulou, in collaboration with the personnel of the Service (see relevant article in this issue).

The archaeologists of the Documentation Office E. Petropoulou and E. Karakitsou kept the minutes of ESMA's meetings, which now meets online, except in limited cases when they meet on the archaeological site.

The photographer T. Souvlakis continued the photographic documentation of the restoration works and the film maker K. Arvanitakis, an outside hire, filmed selected works from the restoration of the

monuments.

Throughout 2019-2020 the surveying engineers D. Mavromati, the supervisor of the works, and S. Kyparissi conducted for the Service various works such as photogrammetric studies and three-dimensional imaging to support all the ongoing works. In order to support the studies of the walls highly accurate topographic observation of predefined spots on the south and east wall of the Acropolis was carried out as well as production of a three-dimensional model, with photographic texture, of the north wall and the north slopes, in the area of the Klepsydra and in 8 more areas of the wall and the Acropolis rock. To support the studies for the Parthenon a three-dimensional model and an orthophotomosaic on a plan of the toichobate of the Parthenon's north wall and of the north side of the Parthenon were made by combining photos from the years 2010 and 2020.

The work of the "Study of the topographic and photogrammetric surveying on the Parthenon" continued by the consortium of "Elliniki Fotogrammetriki Ltd" and "Fotopo S.A." under the supervision of D. Mavromati; S. Kyparissi produced three-dimensional models of the dismantled architectural members with the use



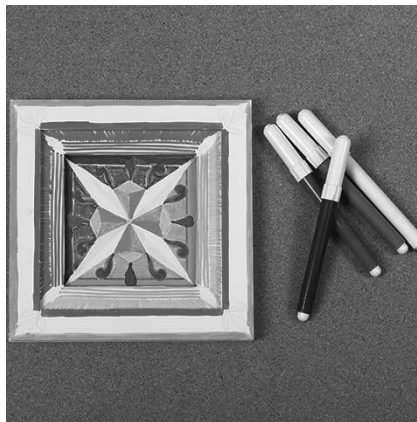
Top, left: The Parthenon: a block from the retaining wall of the west pediment (Δ.TA.I.5) before the conservation works. Top, right: the same block after conservation. Photo A. Panou, 2020. Bottom, left: The Propylaia: a block of the portal wall of the north wing (B.Θ.I.7) before the conservation interventions. Bottom, right: the same block after conservation. Photo P. Vlachouli, 2020

of photographs processed dimensional models and orthophotomosaics of the plan of the area of the Chalkotheke, the rock on the west of the Parthenon after dismantling the base of the crane and also of areas of the rock that were to be covered after the construction of the walkways around the archaeological site.

Finally, after the earthquake in July 2019, orthophotomosaics of the ceiling paintings found in the building where YSMA is housed, on 10 Polygnotou St., were produced.

During the years 2019-2020 YSMA's Information and Education Office employed the archaeologist Eir. Kaimara, acting as its director, and the archaeologists A. Leonti and M. Tsiolaki. One significant event of 2019 was the two-day programme "Acropolis and Restoration" that happened on the Acropolis site at the end of March; students and teachers from 14 schools of Attica participated. In the same period YSMA provided schools with educational museum kits that were used by 8.500 students; two new family trails leaflets were designed and printed for the families visiting the Acropolis Museum. All these educational programmes designed for inside the museum were suspended after the pandemic in March 2020. However, YSMA responded by creating digital applications that 68,000 people visited in the first half of 2020 and since the beginning of the restriction measures. During the second half of the year and within the context of celebrating 45 years of ESMA, the digital applications increased with new digital activities addressing both school units and families (see relevant article in this issue).

YSMA's Accounting Office, whose head is P. Katsimichas, and where the employees M. Mouzoura, E. Soulaou, A. Kapalou, and A. Moshouris work, has significantly contributed during that period, firstly, to the demanding process of managing and monitoring the funding programmes (NSRF and PIP) for the work of the restoration and conservation of the Acropolis monuments, and secondly to the preparation and submission of



Coffer. Student work

the proposal for the funding by the Recovery and Resilience Fund.

E. Zygoras has greatly contributed to the effective management of the materials after the secondment of P. Karabetsou, the head of the Office, to the central offices of the Ministry of Culture and Sports. Finally, YSMA's Administration Office efficiently conducted its administrative duties with the valuable input of the supervisor Ch. Papanikolaou and P. Konstantopoulos and E. Drakopoulou, who was transferred to the Office after she had been relocated and advanced from the Conservators sector to the sector of Administration-Finance. The number of people employed in this Office is just sufficient for the escalated increase of the administrative work of the Service during the pandemic.

YSMA's participation in works enhancing the Acropolis

YSMA, since the beginning of its operation, has been supporting actions organised by the Ephorate of Antiquities of the City of Athens, in the period 2019-2020 though, this collaboration became even more extensive. Within the context of preparing infrastructure works for improving the use of the archaeological site, YSMA participated in the needed works for the installation of the new elevator, the improvement of the lightning protection of the area, the recording of the networks of strong and weak currents of the Acropolis and the new lighting of the Acropolis monuments. It also undertook the ardu-

ous task of paving the new walkways for the visitors.

The replacement of the old elevator with a new modern lift, a requirement approved by both the previous and the present political leadership of the Ministry of Culture and Sports, was certainly a complex and demanding work that had to be completed within the shortest possible time. The old elevator was installed in 2004 on the occasion of the Olympic Games held in Greece to make the Acropolis accessible to people with mobility problems, and although it was supposed to be a temporary solution, it operated continuously for about 15 years. The most appropriate position for that elevator was on the north slope where a wall had been constructed in the 1930s to strengthen the rocky incline. This position allowed the minimum number of interventions on the ancient wall as it evaded anchoring the elevator's mast on the wall and dismantled from the wall only one ancient block to construct the visitors pathway. The access included two parts, from the level of the Peripatos, the ancient perimeter road round the Acropolis, the visitors had to move the lowest six meters of the elevation difference on a transfer platform in order to reach the cabin of the elevator. Then they got out of the elevator at a level 30 meters above the Peripatos, on a wooden platform projected from the wall, on the level of the Erechtheion.

Since the operation of the elevator presented problems and some small stones had fallen from the Acropolis wall in its area, discussions had already started since the end of 2018 for the need of its replacement. In the first half of 2019 the cooperating bodies of the Ministry of Culture and Sports, the Ephorate of Antiquities of the City of Athens, the Directorate of Studies and Conduction of Technical Works in Museums and Cultural Buildings, the Directorate of Prehistorical and Classical Antiquities and YSMA set the specifications for the new work, including necessary works for strengthening the rocky incline on which the new lift would be anchored, and looked for companies that could undertake the work. The Min-

ister of Culture and Sports Dr Lina Mendoni, made the issue a top priority and in October 2019, the Central Archaeological Council approved the "Specifications of position and required works for installing a new lift on the Acropolis", according to which the new elevator would be of variable inclination (slope lift) in order to transfer the visitors from the level of the Peripatos to the top of the rock, and so be a modern construction of highly technical and aesthetic specifications living up to the international reputation of the monuments on the rock.

A crucial parameter for the implementation of the work was the task of its outsourcing. It is obvious that time was of the essence as the Athens Acropolis receives the highest number of visitors in the country and so people with disabilities should have had the sooner possible the opportunity to visit. Yet only the process of finding the right contractor would have taken months. This delay seemed that could have been overcome with a funding from the Onassis Foundation. Then, under the supervision of George Didaskalou, the Secretary General of Culture, actions were taken not only for the timely completion of the studies but also for covering the specifications set by the various governmental bodies. In parallel, a group of supervisors was formed under the guidance of D. Michalopoulou, the head of YSMA's Technical Office of the circuit walls. The work started in June 2020, after consolidating the wall on

which the rails of the elevator would be anchored, and on December 3, 2020 the inauguration of the work was conducted with the presence of the Prime Minister, Kyriakos Mitsotakis. Moreover, discussions on how to enhance the walkways had started since the beginning of 2020 (see relevant article in this issue).

Despite the heavy criticism both the new elevator and the visitors' walkways received, the two works enhanced a lot the experience of visiting the Acropolis archaeological site, while there has been a distinct decrease in the number of accidents that happened in areas where the rock slants or it is slippery. Finally, the new lighting of the monuments, implemented on a study conducted by the company Deko-Lighting Design and funded by the Onassis Foundation, improved the previous lighting which, although when firstly used in 2004 was impressive, it presented problems because of its age. The new lighting enhanced the monuments and the new technology of the lighting used has improved energy efficiency.

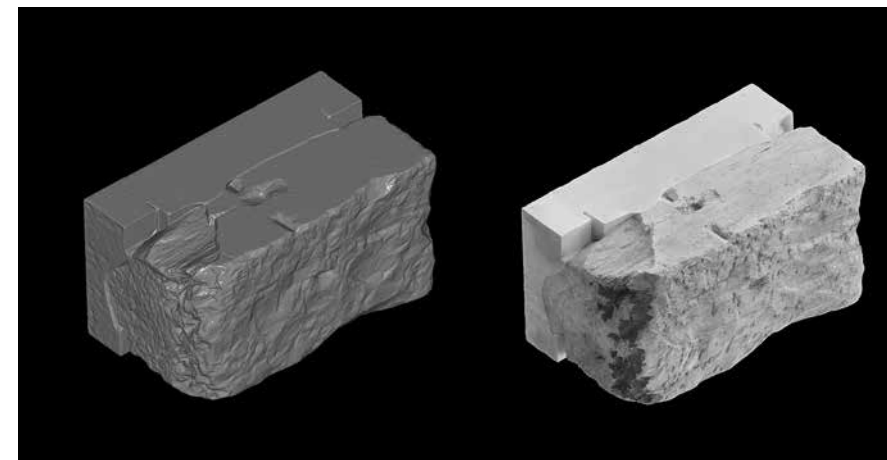
At the end of 2020, the two issues that were mainly discussed during ESMA's meetings, the works that need to be done to deal with the problems on the Agrippas' monument and the restoration of the west access to the Acropolis were included in YSMA's action programme. The organisation of the next International



The new elevator for people with disabilities on the north slope of the Acropolis. Photo T. Souvlakis, 2020

Meeting for the restoration of the Acropolis monuments was to be scheduled soon, whereas the problems caused by the pandemic continued to create a volatile condition that could affect the progress of the restoration works on the Acropolis monuments.

Vasiliki Eleftheriou
Architect Engineer
Director of YSMA



Three-dimensional model of the inner block 2.28 of the north wall of the Parthenon. Photos-Production: S. Kyprissi, 2021

The construction of walkways on the archaeological site of the Acropolis is part of the enhancement works in the area; responsible for this site is the Ephorate of Antiquities of the City of Athens. We should though underline the valuable contribution of ESMA's President, Prof. M. Korres, who insisted on correlating the works with the enhancement of less prominent monuments of the archaeological site, YSMA's crucial input for the implementation of the work, as well as the severe criticism it has received.

ESMA has shown interest in the issue of the visitors' walkways on the archaeological site of the Acropolis since its establishment, and the first time they confronted the issue was in 1977 by designing a walkable route running along the Panathenaic Way, from the Propylaia to the north side of the Parthenon. A network of walkways was constructed in 2004, on the occasion of the Athens Olympic Games, which also ensured that people with mobility problems could have access from the new elevator to the old Acropolis Museum, still in operation. Although the work was the responsibility of the Ephorate of Antiquities, ESMA and YSMA made a major contribution, due to the importance and urgency of the project. In 2011 the need to repair the existing walkways brought the matter back to the fore. The study "Enhancing the existing walkways for the visitors of the archaeological site of the Acropolis" by G. Christakopoulos and E. Alexandraki, together with the replacement of the cordoning –research conducted by R. Christodouloupoulou– were discussed and approved in two ESMA meetings (12th/15.12.2011 and 2nd/9.2.2012). A prerequisite for the new design was the preservation of the old walkways and their best possible enhancement by aesthetically adapting them to the existing natural environment, while at the same time it was decided to release the planning decisions from the strict and restrictive regulations needed for people with disabilities in order to avoid solutions that would alter the aesthetic value of the monuments. The work was conducted by YSMA in 2013 and was funded by NSRF (2007-2014). The contractor was



A view of the Panathenaic Way, from the Propylaia towards the Parthenon, before conducting the enhancement works on the walkways. Photo YSMA/ESMA Archive, 2010



A view of the archaeological site from the NW corner of the Parthenon, before conducting the enhancement works on the walkways. Photo V. Eleftheriou, 2011

selected after a public tender was carried out, whereas the work was supervised by engineers working for YSMA and the Ephorate of Antiquities.

In 2018, after the Ephorate of Antiquities of the City of Athens expressed its interest for the repair and extension of the walkways towards the south and east of the Parthenon, YSMA provided plans of topographic backgrounds of the archaeo-

logical site to assist the preparation of the relevant study. ESMA raised the matter again at the beginning of 2020 when the drafting of the study "Designing and paving the walkways on the Acropolis archaeological site for people with mobility problems" was contracted to the company "NAMA Consulting Engineers and Planners S.A." within the framework of funding received by Onassis Foundation. Throughout the period of preparing



A view of the Panathenaic Way, from the Propylaia towards the Parthenon, after conducting the enhancement works on the walkways. Photo T. Souvlakis, 2021



A view of the archaeological site from the NW corner of the Parthenon, after conducting the enhancement works on the walkways. Photo V. Eleftheriou, 2021

the study employees of the relevant governmental bodies (YSMA, the Ephorate of Antiquities of the City of Athens, The Directorate for the Restoration of Ancient Monuments and the Directorate of Prehistoric and Classical Antiquities) met with those conducting the study and examined the in situ archaeological evidence, indicated by ESMA's President, which had to be considered while deciding on the new walkways.

Thus, the proposal submitted to the competent authorities of the Ministry of Culture and Sports in May 2020 included not only works that would enhance the surface of the walkways but also the re-definition of their borders according to archaeological evidence –periboloi and propyla from the temene of sanctuaries, carvings on the shrines of votive offerings and others. Both ESMA (on 15.5.2020) and the Central Archaeological Council

(on 19.5.2020), although unanimously approved the proposal, they made some important suggestions.

An important recommendation concerned the need to explore various possibilities for the selection of the appropriate material suitable for paving the walkways. A work group was quickly formed consisting of the members of ESMA M. Korres, V. Kaselouri, P. Koufopoulos and M. Mertzani and YSMA's engineers V. Eleftheriou, D. Michalopoulou and E. Aggelakopoulou which undertook the task of looking into materials and choose the appropriate for the paving of the walkways. Given the fact that the walkways should also be used for at least a decade in the restoration works and specifically for withstanding the load of transferring the heavy marbles for the Parthenon, the materials sought had to be resistant to time, of a thickness from 4 to 10 cm, available in the market and accompanied by quality certificates. ESMA in its meeting 11/24.7.2020 had to choose between samples of compositions consistent with the specifications set by the Service, which had been prepared by three companies. After examining the compositions of the architectural concrete Artevia–Stone, of the company Lafarge Beton, which were acceptable for their quality and aesthetic result, ESMA agreed to use them only for the existing walkways, which needed urgent repair, and not for the extensions –separating the work into A and B stage. Stage B would have been implemented after conducting further research in order to choose a material of less resilience. There was though a matter that needed clarification: during that enhancement, the new paving should have been done according to the approved plan, and as a result the restoration of the Panathenaic Way and the route to the old Acropolis Museum would have been extended. In addition, the Panathenaic Way was decided to be of a different colour from the plateaus and the temporary worksite trails.

Thus, when the approved decision for the study with reference number ΥΠΠΟΑ/ΓΔΑΠΚ/ΔΙΠΚΑ/ΤΠΚΑΧΜΑΕ/ 225099/155875/4618/2547/3.9.2020 was published, the study for the implementation

of stage A had already started. After its approval (ΥΠΠΟΑ/ΓΔΑΜΤΕ/ΔΑΑΜ/ΤΜ ΑΜ/505842/57075/1903/885/22.9.2020), the paving started in the middle of October 2020 after conducting lengthy work around the site to define the borders, and also to try out many samples of compositions and finally chose the three compositions that were used. The contractor of the work was the company “Papadopoulos, K.E. Ltd”, the consultant for the implementation of Artevia–Stone was K. Dritsakos, representing Lafarge. The team from the Ministry of Culture and Sports that supervised the works consisted of Dr M. Lefantzis, architect, working for the Directorate for the Restoration of Ancient Monuments, who was in charge of the work, the architects K. Mamalougas and V. Manidaki from Acropolis Restoration Service, the engineers from the Ephor-

ate of Antiquities of the City of Athens G. Christakopoulos and E. Alexandraki and the archaeologist M. Tsihli from the Ephorate of Antiquities.

The team, which also made an important contribution, was the one that had undertaken the geometrical documentation of the areas the walkways covered and provided high-definition plans. Photographs were taken by S. Gesafidis, working for the Directorate of Research and Technical Support for Restoration Projects, measurements were taken by the surveyor engineer I. Partsinevelos and the photogrammetric plans were designed by YSMA's surveyor engineer, D. Mavromati, who was in charge of this work.

Another essential work was the transfer of many architectural members from the Parthenon, where they had been moved

and arranged according to where they had come from, to the area at the NE of the monument. These architectural members had to be moved to nearby positions in order to create a flat open area from where visitors could see the monument better; this work was conducted by the worksite crew of the Parthenon Office under the supervision of R. Christodouloupoulou. The crews of YSMA also moved a fewer number of members to other areas of the archaeological site.

YSMA effectively contributed to the work by the technical support it provided to the contractor, especially the personnel of its electromechanical support team, under the supervision of G. Kehagias, and the operators of the mechanical equipment.

Although the work is not restorative, the area it covers on the site required the

adoption and implementation of principles that define all contemporary interventions in monuments; among them the necessary documentation before, during and after the interventions, the respect to the values and the original materials of the monuments, the distinction between original and new materials, and most importantly the principle of reversibility. The last one was really crucial as the use of concrete is gradually being decreased in the restoration of the Acropolis monuments. However, the case of the walkways is substantially different as the largest part of the new walkways were paved on older layers that had also been constructed with concrete. On the areas of the rock though, which were for the first time laid with concrete, the paving is really thin, not adhered to the substratum and totally separated from it.

The specifications for the used poured material required to have a thickness between 8 to 10 cm and to be self-supportive so as not to require adhesion to the substratum. Between the substratum and the new material, a separating film was placed, thus ensuring the desired reversibility of the intervention. A layer of

gravel, filling the cavities of the rock, not only contributed to that separation, but also provided for the height difference in the areas where the thickness of the construction had to be larger than 8cm. In the areas where the paving material had to have less thickness (about 5cm) because of archaeological evidence, light reinforcement was placed to strengthen the adhesion of the material and avoid fractures. The reinforcement, galvanised construction mesh of 5mm, having loops of 15X15 or 5X10, is interrupted in the areas of the joints that had been constructed every 2.5 m. Therefore, if in the future it is decided to remove part or all the paved surfaces, then it is possible to move these separate pieces that weigh about 1.5 tons. This was also confirmed when two samples were removed without causing any damage to the rock on which the samples had been poured.

At first glance, it is obvious that despite the little difference between the previous and the existing situation, the work of redesigning and constructing the new walkways benefited the safe movement of the visitors, enabled people with mobility problems to move around the monuments and contributed to promoting archaeological evidence which is testified by the abundance of carvings on the Acropolis rock and traces of votive monuments such as the Kallimachos monument.

The work was completed in two months, within the given timetable, thanks to the dependability, the long hours devoted daily, and the committed teamwork of everyone involved; that is, all the supervisors, the people in charge of YSMA's worksites, ESMA's President and its members, the contractor and its partners, and of course the supervision conducted by government officials of the Ministry of Culture and Sports. We should also mention that a factor that contributed to the timely completion of the work was the preventative measures against covid-19 that led to conducting most of the works when the archaeological site was closed for the visitors. That was also another reason why everyone involved made a painstaking effort to avoid delays.



*Removing samples to test out the adhesion of the material on the rock and confirm the intervention reversibility.
Photo T. Souvlakis, 2021*

The completion of this work together with other works implemented during 2020 (the construction of a new elevator, the lighting of the monuments and the enhancement of lightning protection) really enhanced the archaeological site which, after the measures against covid-19 were cancelled in May 2021, opened to the public. It is certain that a lot of works remain to be done, some will start in the immediate future, while others, such as the management of the visitors around the archaeological site, require the coordination of many governmental bodies and different Ministries.

All of us who participated in the process are really grateful to our tireless teacher M. Korres who, by sharing his knowledge and thoughts, revealed to us archaeological testimonies the Acropolis rock continues to preserve.

Vasiliki Eleftheriou
Architect Engineer
Director of YSMA



Works of laying the walkways. Top left: covering the rock with gravel and placing pipes for cable routing. Top right: laying concrete on the protective film. Bottom left: laying concrete in an area where metal reinforcement is incorporated. Bottom right: filling concrete to even the contact of the walkways with the natural rock. Photos V. Manidaki, 2020.



*During the works of placing a marble slab to label the choragic monument of Callimachus.
Photo K. Mamalougas, 2021*

CONTRIBUTORS TO THE PROJECT OF PATHWAYS' RECONSTRUCTION

Study and implementation supervision

M. Korres, Professor Emeritus NTUA, President of ESMA
Committee for the Conservation of the Acropolis Monuments (ESMA)

Study

NAMA Consulting Engineers and Planners

Contractor

K.E. Papadopoulos, Sole-share holder LLC

Concrete technical advisor

K. Dritsakos, Lafarge Beton

Working group for the paving material

V. Kasselouri, Chemical Engineer, Professor Emeritus NTUA, Member of ESMA
P. Koufopoulos, Professor of the University of Patras, Member of ESMA
M. Mertzani, Head of the Directorate of Conservation of Ancient and Modern Monuments, Member of ESMA
V. Eleftheriou, Architect Engineer, Director of YSMA
E. Aggelakopoulou, Chemical Engineer, Head of the Office for surface conservation
D. Michalopoulou, Civil Engineer, Head of the Walls Restoration Project

Work supervisory staff

M. Lefantzis, Architect Engineer, Directorate for the Conservation of Ancient Monuments, Coordinator of the supervising team
K. Mamalougas, Architect Engineer, YSMA
V. Manidaki, Architect Engineer, YSMA
E. Alexandraki, Civil Engineer, Ephorate of Antiquities of the City of Athens
G. Christakopoulos, Architect Enginner, Ephorate of Antiquities of the City of Athens
M.Tsichli, Archaeologist, Ephorate of Antiquities of the City of Athens

Geometric documentation –

Implementation of walkway edgings

Supervision: M. Korres, President of ESMA
K. Mamalougas, Architect Engineer, YSMA
V. Manidaki, Architect Engineer, YSMA
D. Andrikou, Archaeologist, YSMA

Topographic surveying

D. Mavromati, Surveying Engineer, In charge of the Office of surveying engineering YSMA
Measurements of ground control points: G. Partsinevelos, Surveying Engineer
Photography: S. Gesafidis, Photographer, Directorate of research and technical support for Restoration Projects

Project technical support

R. Christodouloupoulou, Architect Engineer, Head of Parthenon Restoration Project
G. Aggelopoulos, S. Kardamis, Heads of Teams, Parthenon worksite
G. Koloniaris, K. Rachoutis, Crane operators
In charge of vertical transportations: M. Gasparis, H Bazakos, V. Tsitsibakos, Marble technitians
I. Dafoulis, Work technician

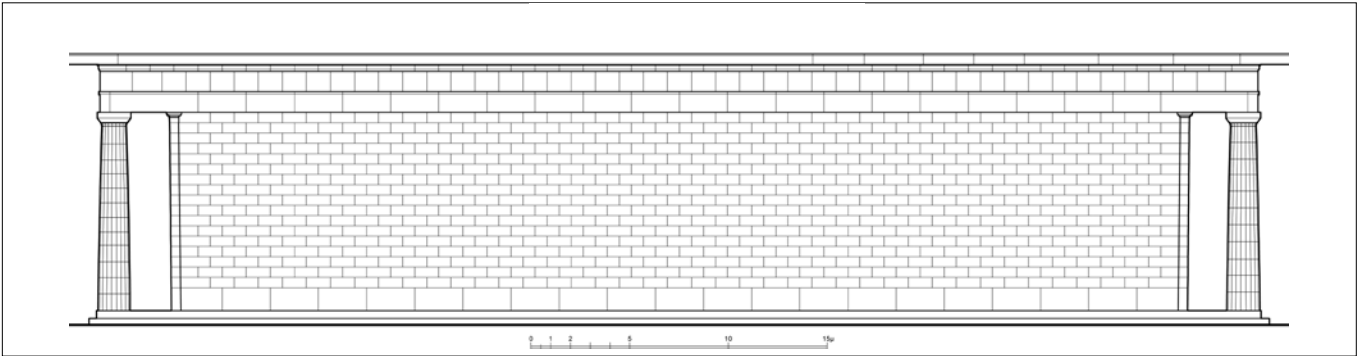
Electromechanical support

G. Kehagias, Mechanical Engineer, In charge of the E/M Team
N. Kontos, Electrician
K. Marinopoulos, Lifting machine operator
S. Nikolopoulos, Work technician

The project was implemented with the kind donation of the Onassis Foundation



Inspection of the works conducted to enhance the walkways by G. Didaskalou, the Secretary General of the Ministry of Culture and Sports, (the fifth from the left), the President and members of ESMA, YSMA's engineers, representatives of the Ephorate of Antiquities of the City of Athens and of the Directorate for the Restoration of Ancient Monuments



Representation of the exterior elevation of the north wall. Drawing: K. Skaris, 2016

The north wall of the Parthenon consisted of a series of upright stone blocks (wall base course or orthostate) followed by 17 courses of blocks, on which the entablature rested. The construction was topped by the crown (thranos or hypodokion) which supported the on wall beams and the coffer slabs of the ceiling of the north pteroma. The connection between the north wall and the three transverse walls was implemented by means of inserting the blocks of the latter into the north wall. The stone blocks at the two ends of the courses of the wall were forming the corresponding antae of the porticoes. The odd numbered courses of the wall (1, 3, 5, ..., 17) consisted of headers, while the rest (2, 4, 6, ..., 16) of stretchers in two rows. The blocks were connected lengthwise with double T shaped clamps and vertically with dowels. The length of the wall at the bottom of the orthostate is 51.5 m, the height from the top course of the cella crepidoma (toichobate) to the 17th block course is 10 m and further up to the ceiling of the pteroma is 13 m, and the width of the courses of the wall is 1.15 m. In antiquity, the orthostate and the 17 courses totalled 1,034 architectural members. In 1687 the Parthenon was blown up that resulted in the collapse of 60% of the wall, whereas a further 25% was demolished by the Turks during the Greek War of Independence. The restoration carried out by Pittakis (1841-1844) used 15% of scattered ancient material on the monument restoring an area of the wall that corresponded to 30% of its initial size.

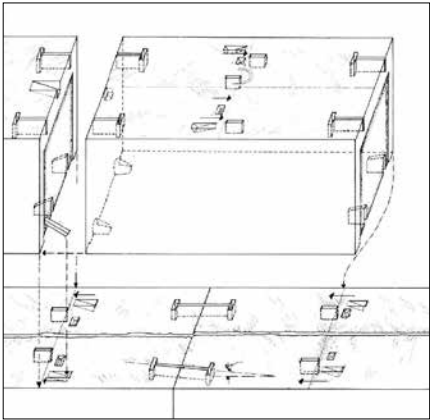
The larger part of the scattered architectural material that is nowadays found

around the Parthenon comes from the long walls of the cella. The majority of the preserved stretchers come from the external rows of the even numbered courses. The fire that happened in antiquity broke into many pieces the interior stretcher blocks, but they remained in their positions until subsequent destruction phases of the monument (explosion in 1687, demolitions carried out by the Turks after 1822) turned them into small fragments; these were either lost because they were used in other constructions or remained around the monument as non-identifiable fragmented material. The interior side of the header blocks face the same pathology; however, their size and shape helped a large part of their mass to remain intact after the fire.

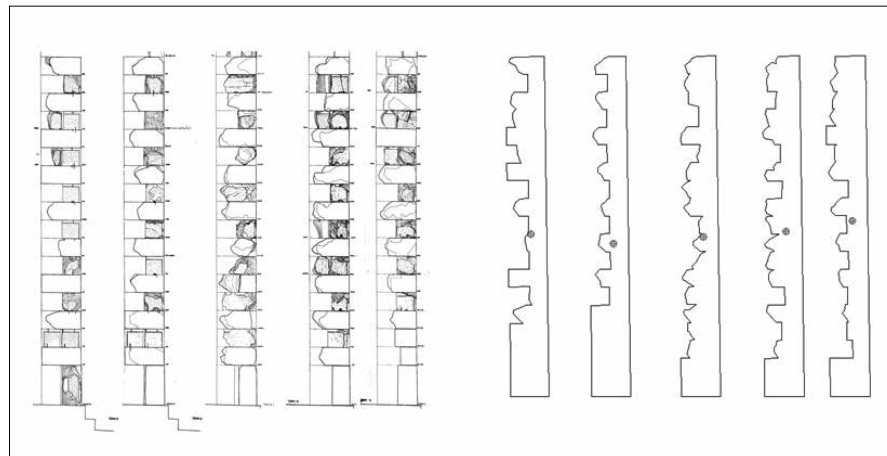
Out of 1,034 blocks of the north wall that existed in the antiquity, 165 remain today in their original position, while on the south wall there remain 156 from a total of 1,033 blocks. The total available material for the long walls of the cella that was found away from their original position includes 854 blocks or large fragments of them. From these blocks 188 have been identified as belonging to certain places of the north wall and 299 of the south wall. In addition, a group of 167 blocks can be placed to corresponding areas of the north wall while 200 blocks remain available to be also placed on relevant areas of the south wall.

The availability of such large amount of ancient material makes the restoration of the north wall possible and worth pursuing. Yet, the wall is inclined towards

the interior of the temple and lacks the interior stretcher blocks i.e. half of the bearing width of the wall in every other course. The overall structural system has, thus, significant structural issues. The available material can recreate a wall of approximately 10m height with a width half the original (55cm) and substantial eccentricity. This eccentricity is both the result of the structural inclination of the wall towards the interior (14.5 cm in 10m height) and the protrusion of the header blocks over the preserved external stretchers underneath them. The bending moment thus implemented in the bearing system reduces further the active width of the wall to about 35cm. An image of characteristic cross-sections of the north wall based on the final archaeological identification of the blocks is presented in the drawing of the next page. The restoration study of the Parthenon, (C. Bouras-M.Korres, 1983), provided the general proposal



Typical positions of the connecting elements of the wall blocks.
Drawing: M. Korres



Left: cross-sections of the north wall after the study Toganidis-Matala. Drawing: K. Matala. Right: outline drawings showing the centroid of gravity. Study-drawing: A. Vrouva

framework for the intervention in the long walls of the cella by making the maximum use of the scattered material, incorporating it in completed courses.

The restoration work of the north wall of the Parthenon cella started at the end of 1992 with dismantling the restoration conducted by Pittakis (1841-1844) and modified by Balanos (1926). The dismantlement was carried out after the proposal of the architect N. Toganidis (1989) was approved; the proposal drew attention to the piling and poor craftsmanship of the apparently misplaced scattered blocks and the use of iron connectors that had caused structural problems (both to the blocks and the entity of the restoration). The dismantling of the material allowed for a detailed study of the blocks, some of which, as it turned out, did not belong to the walls of the cella. Taking all this information into consideration, N. Toganidis conducted a new study (1994); in 1997 it was approved to gradually conduct works in stages, the initial stage being the course of the toichobate, the orthostate and the first two courses of the 17 in total. In the years that followed the same architect working together with the drafter K. Matala conducted a supplementary study on the repositioning of the scattered blocks to their original positions (2000). Matala actually continued until the year 2010 to draw detailed observations of the blocks enriching so the drawings of areas where

the blocks had been repositioned. The architect K. Parashi together with N. Toganidis conducted in 2002 the study for the restoration of the south wall of the cella where they presented analytical tables of inventorying the total number of the scattered material from the two walls. These two studies were presented at the 5th International Meeting for the restoration of the Acropolis monuments (October 2002).

The data obtained by the identification of the original placing of the scattered blocks became the base for a structural research concerning possible restoration options. The civil engineer K. Zambas had already verified (1997) the movement of the wall and the toichobate blocks –in his study for the restoration of the Opisthonaos– and had conducted an evaluation study on how the ancient fire had altered the geometrical characteristics of the wall. The civil engineer E.-E. Toumbakari, while studying the north wall orthostate (A study of the structural restoration of the orthostate's blocks of the Parthenon north wall of the cella, v.1, 2006), conducted a thorough analysis of matters regarding the pathology of the wall blocks and identified the need for a total consideration of its structural system.

The discussions that followed focused on possible solutions in terms of adequate and compatible materials that could be used for the reinforcement of the weak-

ened structural system of the wall. It was widely agreed that the original structural system should be respected and no other than marble and metal connectors must be used. Thus, the decisions to be made was the extend of the intervention in correlation with the need for new marble supplements. In 2008, considering the high demands of the project, it was found necessary to examine the stability of the Parthenon long walls under dynamic-seismic load for the general outline of the at that time proposed architectural solutions. The National Technical University of Athens and the Laboratory for Earthquake Engineering (I. Psycharis 2008) carried out this in the framework of YSMA's research programme. The main conclusions that concerned the restoration of the north wall were in brief the need to reconstruct part of the north end of the original cross wall of the cella as a buttress and the necessity to provide adequate adjacent bearing surfaces between the blocks so as to transfer safely the construction loads to the toichobate.

While trying to establish a standard for the shape and extend of the supplements many solutions were discussed and rejected, such as: a) using supplements similar to the ones used for the restoration of the interior surfaces of the Erechtheion walls –i.e. imitation of a burnt surface, b) using fullwidth supplements in particular vertical zones, c) using gradual supplementation of the width of the wall, with the bottom courses fully supplemented, the main part of the wall height would be supplemented to the 75% of the initial wall width and the top courses would bear the minimum necessary supplements, d) supplementing entirely the width to the 75% of the original. An important drawback of all the aforementioned solutions, due to the large-scale intervention, is the production of forms and textures, apparently irrelevant and incohesive with the monument's structure, that will certainly degrade both aesthetically and scientifically.

YSMA presented the matter of the possible forms of the restoration of the north wall in the 6th International Meeting for the restoration of the Acropolis monu-

ments (October 2013); it also assigned the architect K. Skaris to prepare designs of alternative proposals based on the study of restoring the ancient material conducted by N. Toganidis and K. Matala. The civil engineer A. Vrouva undertook the preliminary structural research for the previously mentioned proposals. A prerequisite for the design was that the proposed solution would not exclude the future use of the ancient material that has already been identified and attributed to the construction up to the level of the beams at the west part of the wall at a height of 13m from the floor of the base. Solutions of partial supplementation of the missing volumes of the blocks, without restoring their full width, were examined. However, the extent of the intervention caused a risk of misinterpreting the original form and the alterations the monument have undergone until recently. Thus, the choices presented were a) the complete supplementation or the reconstruction of the minimum possible number of the blocks towards the internal surface of the wall that ensure a transfer of the loads towards the toichobate through successive bedding b) the complete supplementation of the entire internal surface of the wall that is missing. The majority of the participants voted for the first solution (a partial supplementation), yet concern was expressed about these areas as they formed strong shapes and shades, whilst questions were raised about future structural problems that can occur due to the unsupplemented areas.

In 2015 the architect K. Skaris conducted an implementation study for the restora-

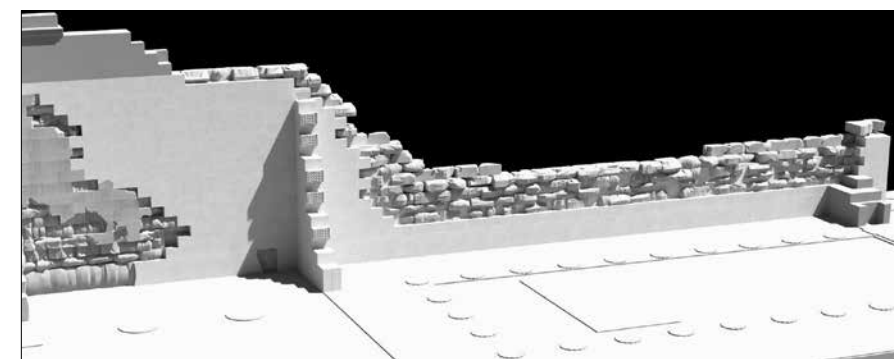
tion of the orthostate and the 1st course of the north wall, which ESMA approved. This study presented new observations regarding the representation of the original design of the north wall that involved its width, the inclination of its internal surface, the orthostate projection towards the interior, the way it joined the transverse walls, the successive movements during the laying of the blocks etc. These observations helped to fully understand the original layout of the 17 courses of blocks of the wall in antiquity.

The study for the identification of the original places of the blocks (Toganidis – Matala) showed that identifications on the part of the wall west from the explosion limit (1687) were based on a combination of factors. On the contrary, the identification of blocks on the part of the wall east from the explosion limit were based on individual criteria (for example the trace of only one clamp). That was quite logical as the part that collapsed after the explosion was later on used in other constructions, (on the walls or in other structures) and so a large number of blocks was lost, whereas the material that was preserved until our days comes usually from the demolitions conducted by the Turks during the Greek War of Independence. Actually, the interior surfaces of the blocks had to a great extent remained intact, as it is attested not only from historical depictions but from observing the way similar surfaces have been saved on the remaining areas of the north, south and west wall, and also on the backing wall of the west pediment which had never been demolished. After taking these observations into account the pro-

posal put forward was to completely fill only the blocks that can be undoubtedly restored to their original size in areas west from the explosion limit, namely the ones demolished by the Turks. Conversely, the blocks that will be repositioned east from the explosion limit will be restored with the minimum possible fillings. Professor M. Korres also remarked that the restoration limit that N. Toganidis and K. Matala had suggested would have to be restricted within the explosion limit in the upper courses. The blocks, which were identified as belonging to the part of the wall beyond the explosion limit, were decided to be gathered horizontally in the lower courses, arranging them in groups according to where they could definitely match with their neighbouring blocks.

The architectural study for the entire north wall up to the 17th layer was finalised after considering the above mentioned; encouraged by the late ESMA President, Prof. Ch. Bouras, it was presented and discussed by the scientific community in the 4th National Conference of Restoration of ETEPAM at Thessaloniki in November 2015. Then the study was submitted for approval by the bodies responsible (ESMA-KAS).

The structural analysis followed side by side the architectural proposals, studied the alternative scenarios as those were laid out since 2013 and focused on the final solution only when it was reached at 2015. The development and delivery of the final solution and all the previous proposals made allowances of all the observations suggested by previous researchers, for example, it has been decided not to implement on the north face of the wall, which is maintained in better preservation condition than the rest, small supplements that are related to failures of connectors and can't provide a substantial contribution to the structural system (E.-E. Toumbakari 2009). Moreover, the results of the research programme that had examined the stability of the various restoration schemes for the Parthenon long walls in 2008, was also taken into account. The research programme of 2008 provided also guidelines for the methodology of the static analysis.



View of the model of the suggested restoration for the interior surface of the cella north wall. Study-production: K. Skaris, 2016



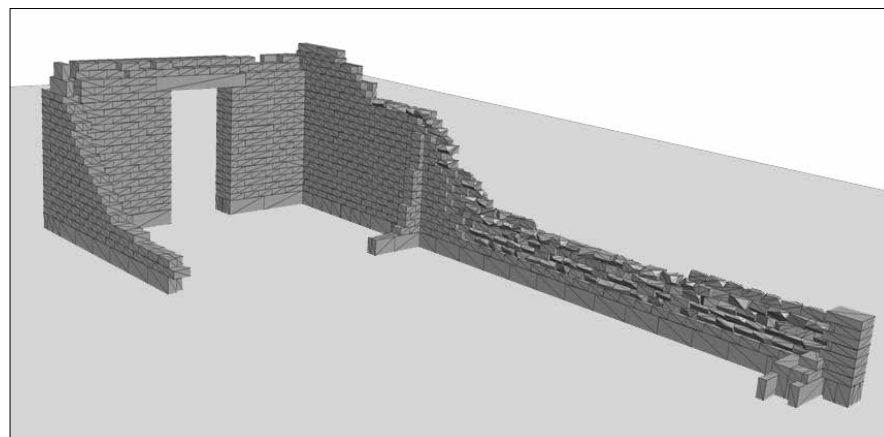
Top: view of the north side of the Parthenon. Bottom: the same picture presenting the suggested restoration for the cella north wall. Study-production: K. Skaris, 2016

In more detail and within the context of the final static study of the works, numerical models of the construction were developed by using data from the research programmes and experiments. In the initial numerical model, the geometric characteristics of the wall were considered simplified and the long walls inclination and connection elements were ignored. Then, the study continued with a numerical model of 1,330 blocks, 150 blocks were examined with their fractures, allowing also for the wall inclination, and 2,878 connection elements. The north wall was examined together with the remaining part of the west and south wall in order to write out an analysis. The final solution incorporated specific seismic scenarios, which were suggested to ESMA by the research programme of the Laboratory of Earthquake Engineering of NTUA (I. Psycharis, 2014).

The dynamic analyses of the models showed that the proposed architectural solution satisfies the demands of the set seismic specifications, without any serious damage, –besides the geometry of the

–up to 25cm. In parallel, the movements along the strong direction of the wall (longitudinal direction) are generally smaller. The contribution of the connection elements lies in the constraint of the width of the maximum and permanent movements, about 50%, whereas when positioned in random places the wall behaviour is closer to a model without any connection. The restoration of the east part where limited supplements are provided behaves adequately as the height of the restoration does not exceed the 6th course. Finally, regarding the stress of the clamping elements, it was observed that only in one out of five seismic excitations examined general failures of the clamps occurred, i.e. exceed their design limit. In this specific case inertia forces dominate.

In addition, an effort was made, within the same seismic scenarios, to evaluate the static efficiency of a restored structural system filled only with the adequate amount of supplements needed in order to fill the exterior surface and the beddings up to the width of the exterior stretchers; in addition, the interior surface was restored only with some burnt stretcher blocks placed on appropriate positions as suggested by the architectural studies regarding the identification and attribution of the architectural members to their original positions. What were examined for this structural system were the effect of the clamping elements and the reconstruction of part of the middle wall.

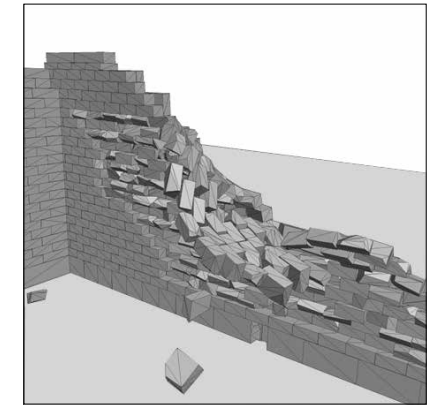
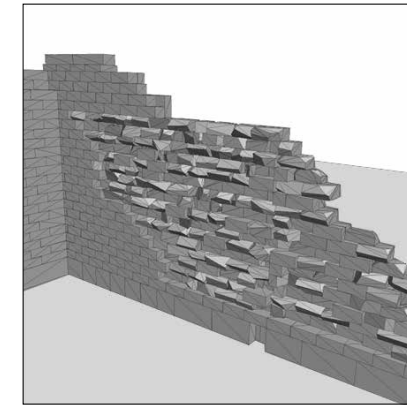


The numerical model used for the analyses of the structural system to be restored. Study-production: A. Vrouva, 2016

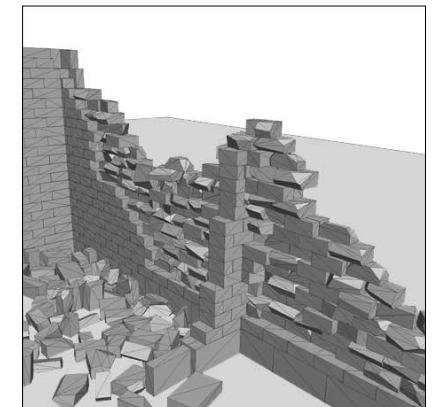
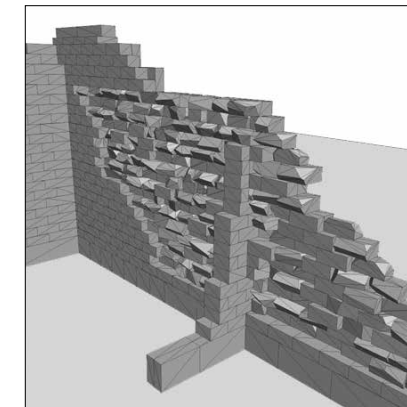
The results of the analyses can be summarised as follows: in the three from the five earthquakes studied and, in the case where the cross wall was not reconstructed a total collapse of part of the north wall between the cross wall and the north wall where the restored wall has considerable height –specifically from the 8th row and above– can be observed. In one of the three cases the connection elements managed to retain the failure. In the case where the numerical model incorporates part of the cross wall's reconstruction, a total collapse of the same part of the wall can be observed in only one of the five seismic excitations considered; and despite the implementation of the connection elements the failure cannot be retained. In order to avoid the collapse, additional supplements should be added to enhance the bedding of the blocks that are to be restored in the middle section between the cross wall and the west portal wall.

The architectural and structural studies were approved by ESMA in July 2016 and were forwarded to KAS that gave its consent in May 2019. The proposed interventions can be summarized as follows:

1. The restoration of all the blocks of the orthostate to their original size and complete supplementing of the first course, which is a prerequisite for the safe bedding of the rest of the construction.
2. The restoration of the area west from the explosion limit by completely supplementing the interior surface.
3. The reconstruction of the north end of the cross wall as it is a necessary buttress.
4. The restoration of courses 2,3,4,5 and partial restoration of the exterior layer of course 6, in the area east of the explosion limit by placing unsupplemented or little supplemented scattered blocks in homologous places.
5. The provision of adequate indication on the fabric for the explosion limit as a fact that caused differential amounts of damage to the ancient material on both



The numerical model of the structural system with the minimum supplements (left) and a snapshot from the moment of its failure (right) during a seismic excitation. Study-production: A. Vrouva



The numerical model of the structural system with the minimum number of supplements and part of the cross wall reconstructed (left) and a snapshot from the moment of its failure (right) during a seismic excitation. Study-production: A. Vrouva, 2016

its sides. The explosion limit in the interior side of the wall will be made clear by the transition from the supplemented surface of the west part to the unfilled surface of the east part. In the exterior a transition zone made out of new material will be formed.

Concluding, the objectives of the intervention are:

1. To rescue the entire available scattered material by incorporating it in the monument and disengage large occupied surfaces of the archaeological site.
2. To ensure the maximum possible efficiency for the suggested structural system, which will not rule out the possibility of restoring any available overlying ancient blocks that have been identified to their original positions up to the level of the beams.

3. To delimitate and make distinct the area that is being restored by placing the blocks in their exact original positions (west part: complete filling in the interior) from the area which is being restored by placing the blocks in homologous positions (east part: minimum supplementation).

Kosmas Skaris
Architect Engineer
Antigone Vrouva
Civil Engineer

Parthenon Restoration Project

During the period 2018-2020 the area B17 (27,500-35,000) of the Athens Acropolis north wall was restored. This specific area is located NE of the Propylaia and corresponds to the west quarter of the construction known as “NW building”. It is delineated from the east by a tower-like buttress and expands to the west in a length of about 7.5 m. The remaining height of the wall at this area is between 6.30 to 6.90 m. This particular area is of unique importance not only because it has preserved its original wall structure, but also because of its building phases that are related to the construction of the NW building.

Given the continuous use of this area, both during the Middle Ages and the Ottoman period, the Acropolis wall was exposed to incessant interventions and restorations so that, if looked from the outside, it resembles a palimpsest. This image becomes even more confusing due to later consolidation works, which are to a great extent undocumented and have been conducted with techniques and materials similar to these of older periods. In the area of the intervention we can distinguish three different sub-areas:

The classical phase: The classical masonry –on which the foundation of the NW building was attached– remains intact to a height of 8 rows in its exterior and of 9 rows in its interior. It is constructed with blocks of Piraeus limestone –harder on the outside and softer

on the inside– built in dry, without any clamps. The blocks on the exterior side are laid with lengths parallel to the face of the wall (stretchers), while the ones of the interior are laid with their shorter ends towards the face of the wall (headers). Although the dimensions of the used blocks show a considerable variation, we could say that the average size of a block is 1.20X0.60X0.45 (h) m. The width of the wall, including the foundation of the NW building, ranges from 1.80 to 3 m. What can be noticed is that the exterior part of the wall inclines towards the interior of the Acropolis, which in its classical phase was achieved through successive small receding of the rows that constructed it (about 2cm per row). Even in this sub-area we can discern small-scale restorations.

Restoration A: The exterior side of the wall, above the height of the 6th row, has been extensively restored with blocks in second use. A large number of them seem to have come from the classical phase of the same wall. The gaps between the largest blocks were filled with smaller blocks, bricks and mortar. This restoration precedes the construction of the tower-like buttress on the east (constructed probably at the beginning of the 18th century), yet we do not know whether it occurred during the Ottoman period or before it.

Restoration B: The exterior part of the classical wall on the west part of the same

area –whose conservation condition was clearly rather bad– was totally cladded during the Ottoman period by masonry consisting of small blocks, bricks and mortar. This cladding stretches further than the area under study, covering a length of about 20m (up to the west edge of the area B17).

Finally we should mention the works conducted in the area during the first decade of the 20th century by N. Balanos, which mainly focused on grouting and filling cracks with cement.

Pathology

The deteriorations observed in this specific area of the north wall are deriving mainly from four factors:

- Material ageing.
- Environmental factors and their effect on construction materials.
- The characteristics and properties of the building materials.
- The means of construction used during the classical phase and also during later restorations.

Specifically, we can observe that the lowest six rows of the wall bear a series of defects, such as cracks, flaking and weathering, however the walling preserves to a great extent its original shape, structure and stability. Conversely, the rows 7-8 of the classical course had been considerably destroyed and filled during “restoration A” with blocks in second use and mortar. The ancient blocks had lost a

large amount of their mass and were fragmented. The masonry, despite being restored, was thoroughly disordered while it also exhibited large gaps. On the upper part of the wall (above the 8th row) the preservation condition was better since in the past mortar was extensively used, however, the tile joints decline from the horizontal level, apparently because of the distortion of the courses underneath.

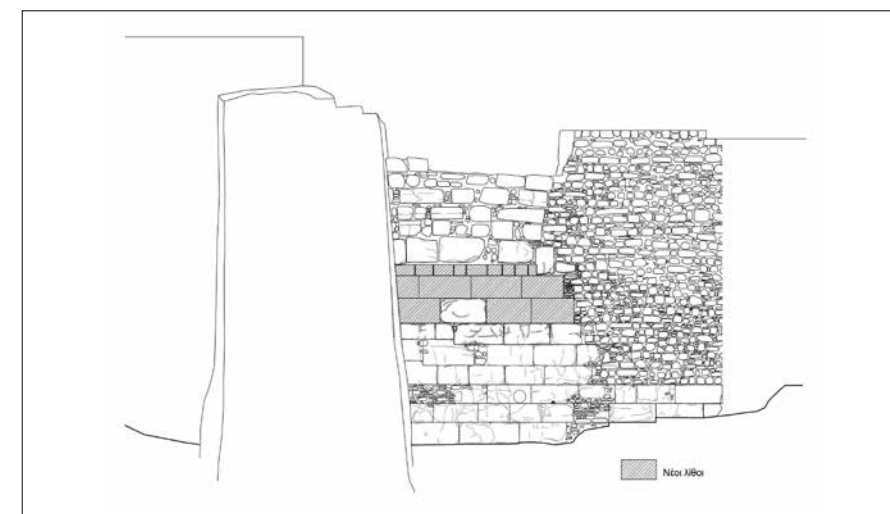
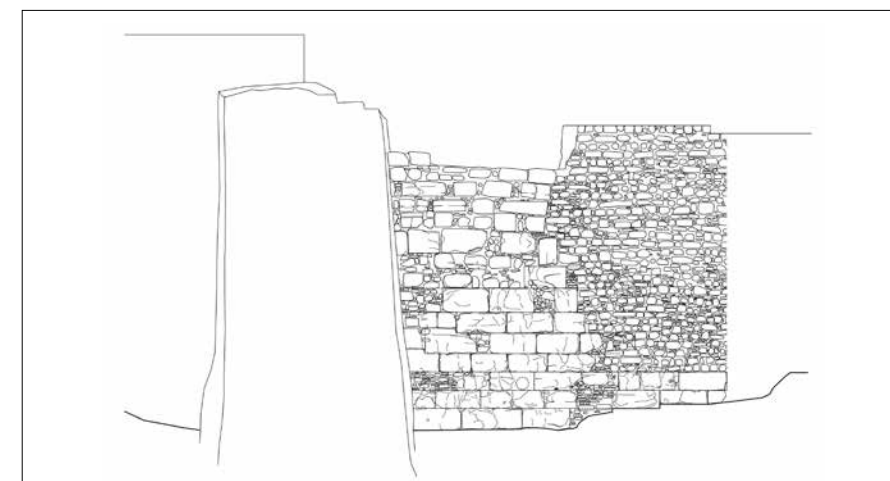
During the Ottoman “restoration B” on the west edge of the area under study, the classical wall was totally cladded by single masonry, consisting of small blocks, bricks and mortar. Its preservation condition is quite satisfactory apart from the fact that the jointing mortar has been washed off in particular areas, especially on its east edge.

Finally, the interior side of this specific area of the wall, which forms the foundation of the west chamber of the NW building, remains until today visible to the level of the rock because the backfilling was removed during the large-scale excavation of the Acropolis. The extended exposure to the weather conditions, in combination with the quality of the material (soft limestone) have caused a large degradation on the blocks of the wall.

Comments on the classical phase and the later restorations

The architect M. Korres has studied the consecutive construction phases of the north wall of the Acropolis and has presented them in a drawing. According to this drawing the construction of the north wall in this specific area happened in successive phases that are labelled with the codes ε1-ε4. These phases describe construction stages and do not necessarily indicate chorological difference. In M. Korres opinion the lowest part of the wall is Themistoclean, while the upper part can be either Themistoclean or Kimonian. The following observations have resulted from close studying and the dismantling of subsequent restorations, in various areas:

1. The direction of the lowest five rows deviates about 8° to the north compared



Area B17 of the north wall of the Acropolis. Top: view before the restoration works. Bottom: view after the restoration works. Drawing: K. Mamalougas, 2019. Substratum: orthophoto from the study “Development of GIS on the Acropolis of Athens”, YSMA 2009

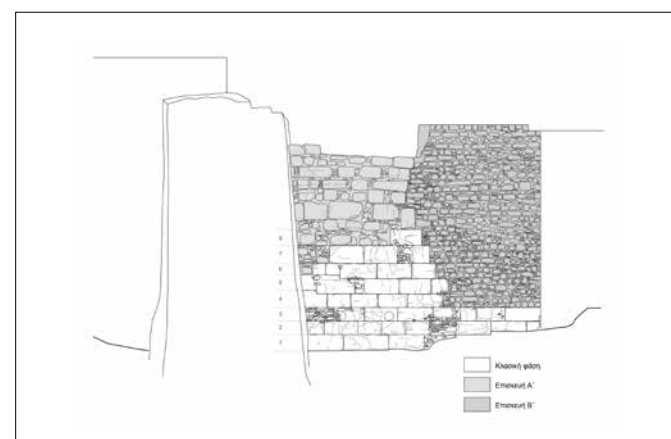
to the direction of the rows from the 7th layer and above. The 6th row functioned as a transition between the 5th and the 7th row, bisecting the angle between them. The difference is also visible in the inner side of the wall despite the fact that the blocks, in this side, do not form an even surface, as they were not designed to be seen. This structural particularity is probably because of the geomorphology of the rock and the foundation of the wall exactly above the cave sanctuary of Zeus.

2. The construction of the classical wall on the lowest five rows is uniform in all its width. On the contrary, from the 7th row and above the construction is double, while the interior and exterior sides remain unconnected. The interior side is

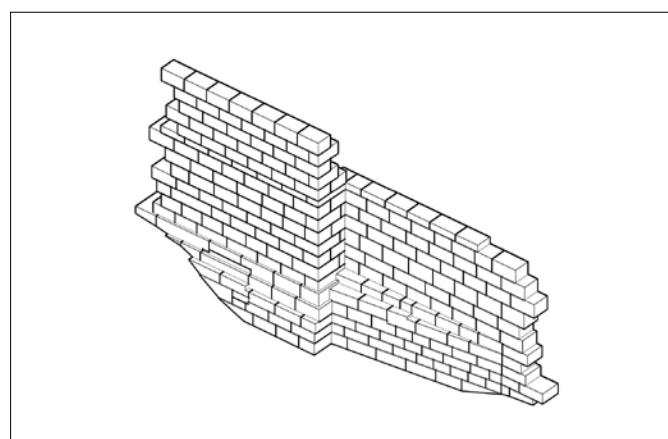
obviously associated with the erection of the NW building to which it functions as a foundation wall. The 6th row, as transitional, was probably built during the first phase, but modified during the second phase.

3. A restoration older than “Restoration A” was found on the east edge of the 7th and 8th rows after dismantling the subsequent dry-stone courses.

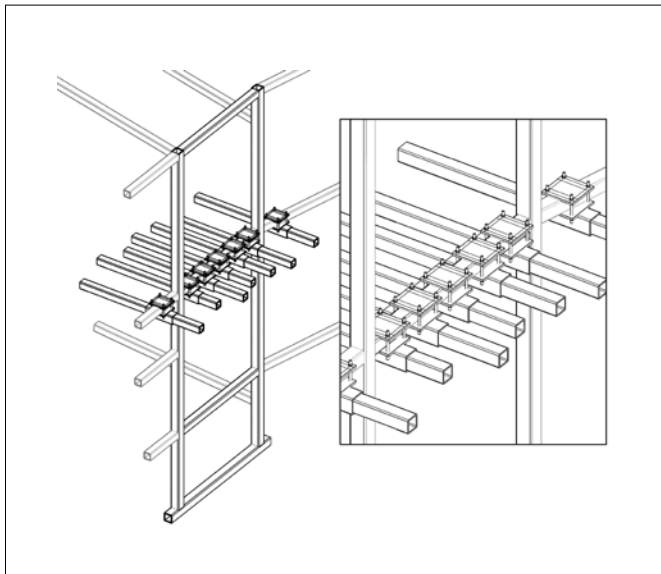
4. During the early Ottoman period, or even earlier, a temporary wedge-shaped wall (Restoration A) was built in order to reinforce the classical wall, on the protrusion of the lowest six rows. Subsequently, the tower-like buttress was built incorporating part of the above-mentioned wall



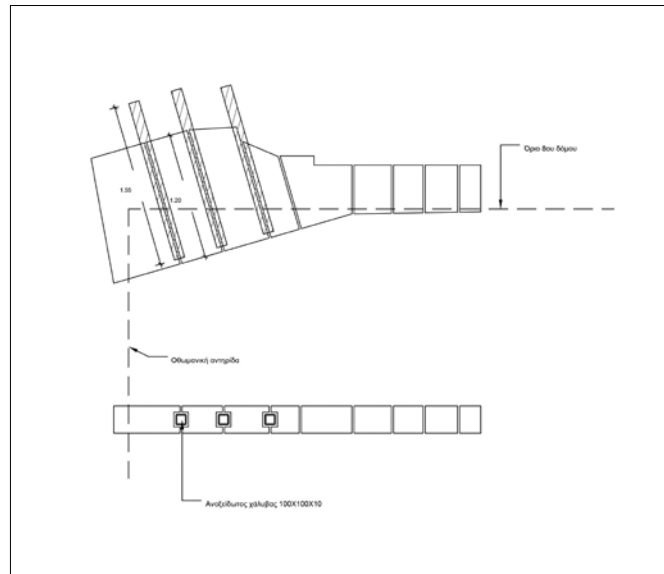
Classical phase and subsequent restorations of the area B17. Drawing: K. Mamalougas, 2019



Representation of the classical phase of the area B17. Drawing: K. Mamalougas, 2019



Anchoring/support system. Study: D. Michalopoulou, 2019



Reinforcement with metal beams. Study: D. Michalopoulou, 2019

and covering a substantial part of the classical wall.

The intervention

It was initially suggested that the original form of the wall in all the height of the area covered by “Restoration A” should be restored. Finally, though, it was decided to preserve the largest part of what was already restored and to restore the classical phase up to the 8th row. As a consequence, the works had to be conducted in the middle of the height of the wall at a depth of about 1.50 m from the exterior surface, whereas the uppermost part of the wall would remain intact. This option demanded the study and construction of a metal system of buttressing-shoring, which stabilised the masonry above



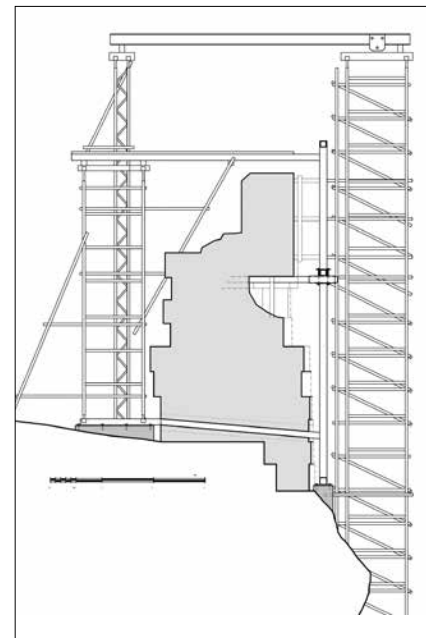
Temporary shoring of the masonry during the dismantling period.
Photo K. Mamalougas, 2019

against horizontal movements and, in combination with shoring on specific areas it supported by absorbing any vertical loads. The metal framed structure was founded on the rock and was connected with the use of metal elements to scaffolding in the interior of Acropolis. Placed at a distance of 0.50-0.90 m from the exterior side of the wall it was equipped with seven metal brackets of adjustable length, vertical to the level of the wall that supported the masonry.

The restoration works in the area B17 started in May 2018. The goals of the intervention were to solve the problems related to the wall condition and also to bring out its original form. Within this context the classical phase of the exterior side of the wall was restored up to the 8th row. For this reason two ancient blocks of the 7th and one ancient block of the 8th row were replaced with new ones. The condition of the previously mentioned blocks was poor, as two of them had lost about half of their mass, while the third one was fragmented. Moreover, a new block on the 7th row and three new blocks on the 8th row were constructed and placed back. These blocks were positioned in places where the classical phase had not survived and had been replaced by masonry during later interventions. Poros limestone from Pitsa Korinthias

was used as the construction material for this intervention. This material has been selected for all the interventions in the Acropolis wall because of its mechanical and physicochemical properties as well as its availability.

Placing the new blocks posed particular difficulty. The specific character of an intervention focusing on the middle of the



Scaffolding, anchoring/support system and bridge crane section.
Study: D. Michalopoulou, 2019

wall –while the masonry above remained in its position– did not allow using the bridge crane to place directly the new members on their position. Moreover, the large number of the metal elements of the scaffolding and the supportive system made apparently easy works, such as the lowering and handling of the new blocks, too difficult to cope with. For this reason, many of the above movements were done manually with the use of crowbars, jacks and any other available means. In addition, for the above reasons the supportive system and the scaffolding had to undergo continuous modifications. Finally we should mention another difficulty we faced when handling the final positioning of the blocks as it had to be conducted only from their front (north) side because their backside, turning towards the interior of the wall, was not accessible.

During dismantling the wall large gaps became apparent in its interior. The gaps had been caused either by the sketchy character of various interventions of the past, or by innate factors such as stone weathering and the construction inconsistencies of the classical course. In order to reassure the consistency of the masonry the gaps were filled with compatible mortar made of calcium hydroxide and metakaolin. The same mortar was used in masonry grouting, wherever it was necessary in the areas of the restorations A and B, as well as in the west side of the tower-like buttress.



Placing a new block in the area B17.
Photo K. Mamalougas, 2019

The conservation of masonry of “Restoration A” above the 8th row demanded the solution of the two problems that had been caused by the geometric and construction inconsistency of the restoration and the classical wall.

1. The east half of “Restoration A” follows a different direction from the classical wall underneath forming a protrusion that in its east edge reaches 70 cm. This protrusion was resting on a provisional masonry which was later on removed in order to restore the classical phase, a factor that created the need to find a new way to support the protruding course.

2. The necessary dismantling for the restoration of the classical phase created a gap of about 26 cm and of a length of 3.40m, between the preserved part of the later masonry and the upper bedding of the 8th row.

The most effective solution was to cover the above gap with new blocks whose dimensions –in their front view– correspond to the dismantled blocks from the restoration; yet, they reach a depth of 0.75 m inside the wall. These blocks protrude from the front view of the wall and follow the course of the restoration that they also support. In order to ensure the static efficiency of the protruding course, the new blocks underneath that correspond to it, were reinforced with hidden stainless steel (304L) profiles.

Specifically, three hollow beams of a profile 100X100X10 mm and a length of 1.50 m were used. The hollow beams fitted in notches, which were opened for this reason on the sides of the four easternmost new blocks, were embedded in the interior of the wall.

The works will have been completed by the end of 2021. Future programmes focus on the protection of the interior side of the wall and the foundations of the NW building. Moreover, the restoration works that will ensue concern the part further east from the area of the east chamber of the NW building. In this way an area sharing common characteristics will be treated uniformly, and the relation of the wall with the formation and construction activity in the interior of the Acropolis will be revealed.

Dionysia Michalopoulou

Civil Engineer

Head of the Project

Kostas Mamalougas

Architect Engineer

Walls Restoration Project



The west edge of the intervention area after placing new blocks
Photo K. Mamalougas, 2019

Research into ancient polychromy on the Parthenon and the Propylaia: the case of the horizontal cornice blocks of the Parthenon

Polychromy in antiquity

The matter of polychromy in the sculptures and temples of antiquity attracted the interest of scholars for the first time in the 19th century. Archaeological findings show that ancient temples and sculptures were decorated with colours; yet, the designs, the composition of the pigments and the methods used to apply them on the surfaces needs to be further investigated.

The colours used in antiquity were mainly coloured earth pigments (red and yellow ochre and others) from the widespread layers of iron oxide found in many places on earth. In addition, they also used the colour minerals of heavy metals, azurite (blue), malachite (green), cinnabar (red) etc. These specific minerals were found in particular mines and were less available; yet, they were put into use long before the classical period, became commodities and were transferred to places far beyond their origins. Finally, there were also synthetic pigments, whose preparation demanded some form of human processing. The most known synthetic pigment of the antiquity is the Egyptian blue, known as calcium-copper silicate, created in Egypt for the first time at the beginning of the 3rd millennium BC, which from there spread around Greece. It is produced by heating together silica sand, copper and calcium carbonate at temperatures of 850-950°C and produces a vivid blue colour.

An inscription found at the Erechtheion mentions the payment given to the encaustics, people who painted on the marble with “caustic” paints. It is clear that the inscription refers to the encaustic technique, a method well-known in the

ancient world. This technique involves using a sharp instrument to initially engrave the outline of the drawing on the marble. The colour pigments were mixed with melted beeswax, which functioned as a binding agent. The heated colour was applied on the marble and then the encaustis (namely the heating, the melting of the wax) occurred, in order to melt the colours and bind the whole painting into a solid homogenous surface.



A representation of the Parthenon entablature according to Julius Springer. In colour in the initial publication.

As far as the polychromy of the Acropolis monuments is concerned, it is worth mentioning the contribution of the European researchers of ancient architecture of the 19th century who had visited the Acropolis monuments. During their study, they created a substantial number of drawings and detailed descriptions of the polychromy not only for the monuments of the age of Pericles, but also from older periods.

These representations were for most of the cases subjective and based on how the people of their time aesthetically interpreted ancient architecture; nonetheless, some of these interpretations were based on the traces of polychromy that had survived till the period of their study.

With regard to the nature of the pigments and the painting technique, there were studies conducted at the same period by the English scientist Michael Faraday in 1827 and the German scientist X. Landerer, Chemistry Professor at the University of Athens, in 1843. These early analyses focused on taking pigment samples from the Parthenon, the Propylaia and other Athenian monuments, but they failed to mention the exact place where the samples had come from. The analyses identified a large number of pigments (azurite, Egyptian blue, hematite, cinnabar, carbon black and others), moreover the two researchers discovered in the samples they had analysed beeswax mixed with various pigments.

However, even today, nearly two centuries after the beginning of the study, there is incomplete or confusing information related to the extent the monuments' surface was painted, the colours and the motifs of the drawings found in every architectural member, the nature and origins of the pigments and the technique used to apply colour on the marble.

The aim of the research on ancient polychromy

Current research into the polychromy of the Acropolis monuments, since the beginning of ESMA's operation, concerns existing reports relevant with the existence of red and blue colour on the tri-

glyphs and the cornice blocks at the entablature of the east side of the Parthenon, which were identified as Egyptian blue and hematite (Kouzei et al. 1989). Then, while applying cleaning interventions in the coffered ceiling of the Caryatids' porch of the Erechtheion visible induced luminescence techniques (VIL) were used for the first time to identify the existence of Egyptian blue (2010-2012). Moreover, after employing analytical techniques important data concerning the stratigraphy of the materials came to the fore. The VIL technique was used in 2012-2013 by YSMA Conservation Department in collaboration with the Acropolis Museum at the west frieze of the Parthenon and it identified the existence of Egyptian blue on the clothes of the horsemen and on the outline of the horses' eyes.

2011 marked the beginning of a systematic observation and documentation of the remaining traces from the painted decoration that can still be seen in many architectural members of the Parthenon and the Propylaia. Given that these are found on the level of the monuments entablature, quite high up from the ground, the areas chosen for the study were the west side of the Parthenon and some are-

as of the Propylaia where scaffoldings had already been placed to assist with restoration works. Innovative diagnostic imaging and analytical techniques were used for the research, as they either do not harm the materials studied or demand a minimum sample of the material (in micrometre scale) in order to draw conclusions about its composition.

The painted decoration of the classical period is saved either in the form of engravings or in scattered colours (in layers or traces) together or under decay crusts and patinas. Traces of polychromy remain in a very good conservation state in the areas mainly protected from direct exposure to environmental factors (under the cornices, on the cymas, the bottom sides of the architectural members etc.). The colours found more frequently on the Parthenon and the Propylaia are blue and red, while green and black appear more rarely.

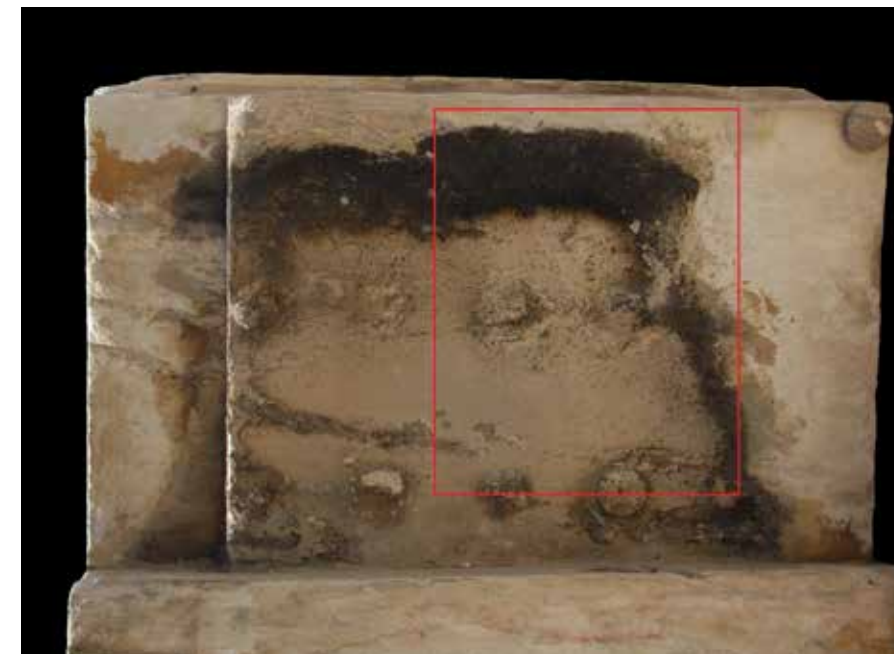
The aim of this project is the systematic study of the areas of the Parthenon and the Propylaia where traces of polychromy still survive or where polychromy is expected to be found under the crust according to past colour representations. The study includes documentation, the

collection of information using imaging techniques to identify drawing motifs that are not visible with the naked eye, identification of pigments and the collection of information concerning the technique of painting the ancient temples. The final aim is to reconstruct the polychromy of the architectural members and better understand how the Acropolis monuments and in general the ancient temples, initially looked like.

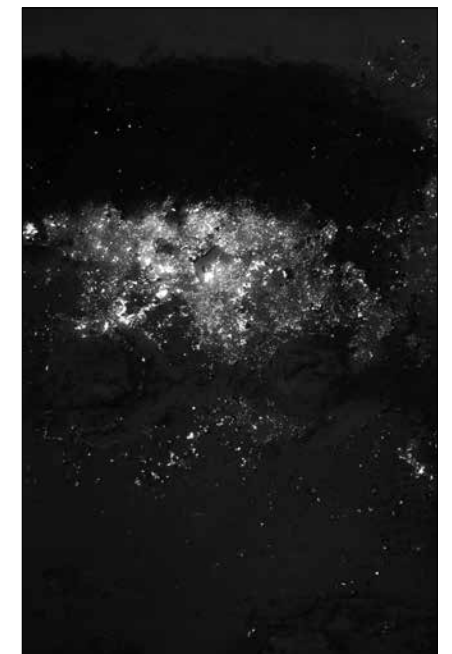
The methodology for the research

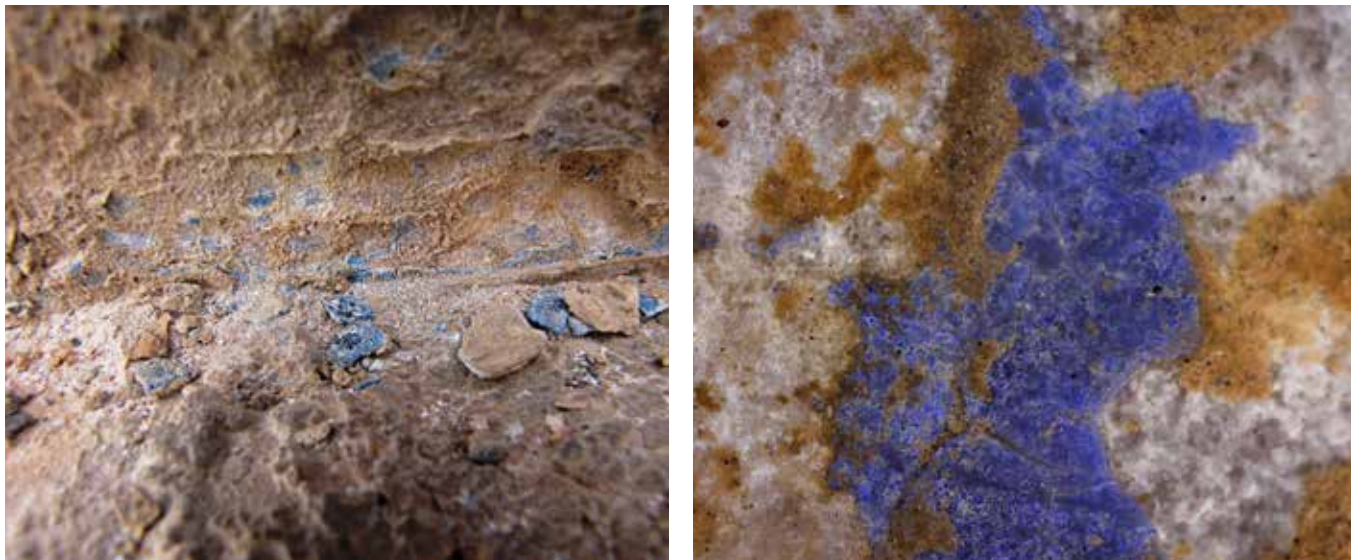
The most appropriate and advanced imaging, non-invasive and analytical techniques were used. The methodology was approved in 2015; the first stage (Phase A) is the archaeological research and then follow the stages of technical research:

1. Imaging diagnostic techniques (in situ evaluation without sampling) - Phase B. These techniques are the following:
 - Raking light imaging, in order to determine the existence of the incising and tools traces in marble surfaces.
 - In-situ optical microscopy (magnification: x30, x50, x120).
 - Visible Induced Luminescence (VIL). It is the main technique to trace the Egyptian blue.



The 4th west cornice block. Left: View of the mutulae and the viae. Black crusts and orange-brown patina layers. Right: Area defined inside the frame in the adjacent photo. Intense luminescence indicating the existence of Egyptian blue.





The 4th west cornice block. Left: north vertical side of the mutulae. Intense blue colour under the crust. Right: a photo from a portable optical microscope (x50) of the blue colour in the adjacent photo.

•Ultraviolet Fluorescence (UVF) imaging, to facilitate the quick detection of fluorescent materials. The personnel of YSMA's Conservation Department were responsible for using the imaging techniques. (Workgroup: On the Parthenon: E.Aggelakopoulou, A.Panou, K. Frantzikinaki, I.P. Kotsifakos, T. Souvlakis, G. Frantzi, A.Sotiropoulos).

2. Non-invasive portable techniques (in situ evaluation without sampling) - Phase C. The non-invasive techniques used for the elemental and molecular analysis of the materials, were the following:

- X-ray fluorescence (XRF)
- MicroRaman spectroscopy.

The non-invasive portable techniques were carried out by Ormylia Art Diagnosis Centre (Science supervisor: Dr S. Sotiropoulou) in collaboration with YSMA's Conservation Department.

3. Microsampling and application of analytical techniques, in lab scale - Phase D. The analytical techniques that aim at providing elemental and molecular analyses of the materials are:

- Stereomicroscope.
- Raman spectroscopy.
- Scanning electron Microscope with microprobe (SEM/EDX).
- Fourier transform Infrared spectroscopy (FT-IR) .

Phase D is being conducted by E. Aggelakopoulou at the Laboratory of the Faculty of Materials Science and Engineering of the School of Chemical Engineering of NTUA in collaboration with the Associate Professor A. Bakolas. The case of the horizontal cornice blocks of the Parthenon, which follows below, is a typical example of the research.

The horizontal cornice blocks of the west side of the Parthenon

Quite a lot of information about ancient polychromy can be collected from the horizontal cornice blocks of the Parthenon, mainly because of their geometry that protects the lower parts of the members. A characteristic representation of the horizontal cornices can be seen on page 24 where the viae are presented in red, the background of the mutules in blue and the taenia at the bottom of the cornice blocks decorated with a yellow or golden meander in red background.

Today in the area of the viae and the mutules there are extensive black crusts and also layers of orange-brown patina resulting from the environmental impact on the marble and the paint layers. In areas where the crusts have lost their coherence and flake off there can be seen traces or even layers of pigments that are found under the products of environmental deposits and decay crusts.

On the fourth (from north to south) west cornice block (west cornice 4), traces of blue pigment can be detected not only on the base but also on the vertical side of the mutule. The VIL technique recorded intense surface luminescence (bright white colour) in the mutule's area under the black crust that corresponds to the existence of Egyptian blue ($\text{CaCuSi}_4\text{O}_{10}$). Non-invasive techniques applied in situ and the use of the scanning electron microscope (SEM/EDX) in the laboratory identified the Egyptian blue and also the existence of beeswax mixed with the pigment.

The extensive use of red colour has been observed in the viae of many cornice blocks. After applying non-invasive measurements in situ and with analytical techniques in the laboratory, the mineral hematite (Fe_2O_3) also mixed with beeswax, was identified. Hematite is the main mineral of red ochre, the *miltos* as it was called in ancient Greece.

The initial carvings of a meander design in the form of a grid (vertical and horizontal carved lines) were found preserved in a very good conservation state at the taenia on the base of the cornice blocks. The design of the meander survives as a crust layer that protrudes from the background of the design, as a micro-relief of low thickness. It seems that the background

of the design on the taenia has degraded more than the meander (differential erosion of the pigment), a fact that can be attributed to various factors, such as the different durability of the pigments used in the decoration of these two areas or the different initial thickness of the various pigments, etc.

In the background of the design sufficient traces of red pigment were identified on the taenia, at the point where the taenia meets with the mutule, as well as in the background of the pattern of the meander. Moreover, at the bottom of the taenia of the eleventh (from north to south) west cornice block we can, even nowadays, discern a whole area of preserved red pigment. The analytical techniques that were applied to micro-samples proved that the pigment corresponds to hematite also mixed with beeswax. Therefore the background of the meander, as well as all the exposed surfaces of the taenia were painted with hematite.

Looking for the colour of the meander there were identified in a macro and micro scale traces of blue-green or blue colour under the crusts in many cornice blocks. The analytical techniques in the laboratory identified the existence of azurite ($2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$), whereas in the green areas of the sample the existence of atacamite ($\text{Cu}_2\text{Cl}(\text{OH})_3$) was revealed. That is probably a product of the chemical change of the initial blue colour, in cases of contact with solutions that contain chlorides. Azurite is a natural blue pigment that is produced from the mineral azurite and found in secondary copper minerals in many places around the world, as well as in Lavrion mines.

Conclusions - Prospects

The research in the case of the west horizontal cornice blocks of the Parthenon has until now brought to the fore the following:

1. A carved grid was used for the carving of geometrical designs such as the meander that ran through the base of the horizontal cornice blocks circumferentially the temple.

2. The mutules of the cornice blocks were painted with Egyptian blue. The viae were



Cornice blocks of the west side of the Parthenon. Top left: The 4th west cornice block: red pigment from the via. Photo from the stereomicroscope. Top right: The 21st west cornice block: the meander grid on the taenia. Bottom left: The 11th west cornice block: a red pigment layer at the bottom of the taenia. Bottom, right: The 14th cornice block: blue colour on the meander under a layer of orange-brown patina.

painted in hematite (red colour). The colours of the mutules and the viae correspond to the representations of the 19th and 20th century. The Egyptian blue and the hematite were mixed with beeswax.

3. At the taenia on the basis of the cornice blocks, the background was painted with hematite and the meander decoration with the blue pigment of azurite. Beeswax mixed with hematite was identified in the red paint. The blue colour of the meander contrasts with some colour representations of previous centuries.

4. The existence of large amounts of beeswax in many micro-samples is in accordance with the first chemical analyses of Faraday and Landerer. However, more investigation is needed to verify whether it is indeed beeswax from the ancient encaustic technique or it had been added at a later time.

This research is in progress and relevant results are expected to come for the archi-

tectural members of the Parthenon's entablature and for selected architectural members of the Propylaia.

Eleni Aggelakopoulou
Dr Chemical Engineer
Head of the Technical Office
for the Surface Conservation

** See the color photos of the article at the following link:
www.ysma.gr/en/open-access/publications/newsletter/*

In general, film archives belong to the wide category of audiovisual archives and can be defined as: “An audiovisual archive is an organisation or part of an organisation that focuses on the collection, management, preservation and access to a collection of audiovisual media” (Edmondson Ray, 1998 “Audiovisual Archiving: Philosophy and Principles”, 3rd ed, 2016). This definition presents two key features: the first one is that it defines an archive as an organisation or a part of it and not as a private collection, while the second one acknowledges that the collection together with the management, the preservation and the access to the material constitute all together –as an entirety and not as separate units– the centre of the activity and not an incidental action of the archive.

The importance of audiovisual archives as a means of cataloguing, documenting and preserving cultural heritage has been universally acknowledged, as a result in 1982 the Convention of the Council of Europe for the audiovisual heritage agreed on the mandatory deposit (of a copy) of all the produced cinematographic material and its accessibility by the public in all contracting states. This requirement involves not only the deposit of a copy (legal deposit) in an officially accepted archive, but also the necessary preservation and protection of the submitted material. 2011 was a milestone in the history of cinema as it is the year when the industrial production of motion picture cameras using negative and reversal films came to an end, a fact that has necessitated the digitisation of any audiovisual production.

YSMA's audiovisual archive
As early as 1983, the Committee for the Conservation of the Acropolis Monuments (ESMA), following decisions of international conventions, started producing films in order to document the pioneering restoration works carried out on the Acropolis monuments. In addition, since 1999, Acropolis Restoration Service (YSMA) that has continued to make films about the works now possesses a rich audiovisual collection that includes more than 500 hours of sound and cine-



Examples from the analog audiovisual archive (motion picture film 16mm, 35mm and super 8mm, betacam and mini dv tapes, audio magnetic tapes)

matic material. These are documents that contain unedited film material of works on the monuments, long shots of the archaeological site and the monuments, complete film productions and extracts from TV programmes focusing on the Acropolis. This collection is valuable since it consists of audiovisual material that preserves and promotes scientific knowledge whereas it also composes a well documented educational material. For this reason and especially because it includes unaltered and intact information relevant to the restoration works, it plays an important role in the history of the monuments and the cultural heritage of the country.

The audiovisual archive of the Service was until 2019 divided in primary analog and digital, while only a small number of analog films and videos had been digitised. However, the sensitivity of the analog media and mainly their inadequacy in reproducing its content made their digitisation imperative in order to save, preserve, and make their content accessible to the scientific personnel.

The writer of this paper supervised the digitisation of YSMA's entire analog film archive that finished in 2019 and enriched the audiovisual documents with approximately 250 hours of additional

digitised material, containing different playback formats in order to facilitate the collection management.

The audiovisual archive of YSMA includes now the following kinds of documents: the analog documents (stored in films, video cassettes, tape cassettes etc.), the born digital documents, the born digital footage, the digitised documents (in various formats, such as .mp4, .mov and .avi), and the primary digitised footage.

The digitisation of the entire archive and the variety of the digital formats that despite being intended for a variety of use (screening, storage etc.) have equal importance, as well as the systematic production of born digital documents, increased the volume of the audiovisual archive, created as such new challenges and needs in searchability, accessibility, presentation, management, digital preservation and also storage and disaster recovery.

The codification of the audiovisual sources
Extending the archive, after the addition of new audiovisual documents of different technical specifications, led to a re-examination of its organisation, so as to make it more manageable and to facilitate access to every interested party. In order to achieve this it was, on the one

hand, decided to codify it again, and on the other, to enrich the old database (DB) in Microsoft Access with metadata that would correspond to the new multifaceted needs. The new paradigms and rules for the codification of audiovisual sources resulted from the contribution of I. Alexopoulos, IT technician, and the supervision of the Head of the Documentation Office, Dr E. Lempidaki.

The process of this codification drew from the logic of the previously existing codification of the analog archive, which incorporated in the name of the document the serial number of its record, the kind (i.e., if it is a picture file or an audio file) and the storage medium (i.e., if it was a file coming from a tape cassette, a video cassette or a film, or stored in an optical disc), however, new codes were added so as to cover the entire born digital and digitised formats.

In this light the audiovisual files received the following codes:
• ΠΙ (from the Greek word pita (πίτα) that stands for 16mm, 35mm and super 8 films) code for the sound and picture files that were produced from films and ΠΙ.Ψ (from the Greek word psifiako (ψηφιακό) that stands for digitised) code was given to their digitised versions.

The code P (from the Greek word karouli (καρούλι) that stands for film reel) was added to this category of documents to indicate audiovisual files that had come from different film reels. For example, the code ΠΙ-20 indicates the primary analog film file from which, after the digitisation, ensued the files ΠΙ-20.P.1.Ψ and ΠΙ-20.P.2.Ψ.

- KA (from the Greek word kasseta (κασέτα) that stands for video cassette) code for the files that come from video cassettes and KA.Ψ code for their digitised versions.
- KH (from the Greek word kasseta ichou (κασέτα ήχου) that stands for audio cassette) code for the files that come from tape cassettes and KH.Ψ for their digitised versions. These files in the previous codification were encompassed in the KA files.
- TA (from the Greek word tainia ichou (ταινία ήχου) that stands for audio tape) code for the files coming from tape recordings and TA.Ψ code for their digitised version.
- ΔΙ (from the Greek word diskos (δίσκος) that stands for DVD and Blue Ray Disc) code for the digital archives that were

stored in optical discs and ΔΙ.ΠΛ code for the files that include born digital footage. The code ΠΛ (from the Greek word plana (πλάνα) that stands for high resolution film extracts) is a new addition and is used to indicate large files of high definition and resolution that include small film extracts from primary footage of an audiovisual file. The primary footage are files that can be stored and used, for example, for the creation of new audiovisual production, but are not meant to be widely used because of their size and technically specific format.

- OA (from the Greek word optikoakoustiko (οπτικοακουστικό) that stands for audiovisual) for all the born digital audiovisual files that were filmed after 2011, a year when digital cameras relegated film cameras to becoming the exclusive tool for the production of audiovisual material, and OA.ΠΛ code for their primary high resolution footage. The addition of the code OA is extremely important as it is the only dynamic category of the audio visual archive, namely, the one that will constantly be supplemented with new documents.

Summing up, the digitization of the entire audiovisual archive of YSMA, mandated the creation of new codes and the enrichment of the old ones, in order for

| Broadcasts | | | | | | | | | | | | |
|------------|--------------|----------------|--|---|----------------------|-----------------------|-------------|------------------|-------------------|---------|-----------|---|
| ID | Accession | Entry date (ε) | Title | Subject | Comments | Monument | Call Number | Storage medium | Format | Version | Source | Relation/rart |
| 2238 | KA-074 | 1/6/2012 | Εργασίες στον Παρθενώνα | Παρθενώνας: Αποσυναρμολόγηση του θρόνου Δ. 02.22. Αφαίρεση καπνικής μεταξύ των Δ. 02.11 και Δ. 02. ΠΛ.4. Αποσυναρμολόγηση του Δ. 02.11. | Εμφ. Neg. 1/2/93, r2 | Παρθενώνας | 1ο υπόγειο | | BetacamSP compact | | | KA-075 |
| 2239 | KA-074.Ψ | 3/2/2020 | Εργασίες στον Παρθενώνα | Παρθενώνας: Αποσυναρμολόγηση του θρόνου Δ. 02.22. Αφαίρεση καπνικής μεταξύ των Δ. 02.11 και Δ. 02. ΠΛ.4. Αποσυναρμολόγηση του Δ. 02.11. | Εμφ. Neg. 1/2/93, r2 | Παρθενώνας | 1ο υπόγειο | XHD (Hard Drive) | .avi | .mpeg | BetacamSP | KA-075.Ψ |
| 2240 | ΠΙ-013.P.1.Ψ | 28/1/2020 | Εργασίες στα Προπύλαια | Ακρόπολη, Προπύλαια. Από 17'-41 έως 22'-34: Ανασκαφή στην υπερπρορριωμική δεξαμενή/Από 23'-16: Απόψεις στο κρηπίδα των Προπυλαίων/Εως 25'-40: Απόψεις των φενομαστικών οροφών των Προπυλαίων πριν την | | Προπύλαια | 1ο υπόγειο | XHD (Hard Drive) | .mov | .mp4 | Φύλμ 16mm | ΠΙ-13.P2.Ψ |
| 2241 | ΠΙ-013.P.2.Ψ | 28/1/2020 | Εργασίες στα Προπύλαια | Ακρόπολη, Προπύλαια. Από 17'-41 έως 22'-34: Ανασκαφή στην υπερπρορριωμική δεξαμενή/Από 23'-16: Απόψεις στο κρηπίδα των Προπυλαίων/Εως 25'-40: Απόψεις των φενομαστικών οροφών των Προπυλαίων πριν την | | Προπύλαια | 1ο υπόγειο | XHD (Hard Drive) | .mov | .mp4 | Φύλμ 16mm | ΠΙ-13.P.1.Ψ |
| 2242 | ΔΙ-079 | 23/1/2014 | Κινηματογράφηση εργασιών 2011-13 | Κιανόκρονα πόντες (40) [04/12/12], Κιανόκρονα συνέχεια (15), Προπύλαια συγκόλληση (56) [21/01/3] | | Παρθενώνας, Προπύλαια | | DVD | | | | OA-058, OA-073/OA-074/ΔΙ-069.ΠΛ/ΔΙ-071.ΠΛ |
| 2243 | OA-032 | 22/6/2020 | | Εως 00:14> Γενική άποψη του ανατολικού τοίχου της νότιας πτέρυγας. Εως 00:21> Γενική άποψη του νότιου τοίχου του κεντρικού κτηρίου. Εως 03:09> Απόψεις του ανατολικού τοίχου της νότιας πτέρυγας. Εως 03:28> Εως 00:14> Γενική άποψη του ανατολικού τοίχου της νότιας πτέρυγας. Εως 00:21> Γενική άποψη του νότιου τοίχου του κεντρικού κτηρίου. Εως 03:09> Απόψεις του ανατολικού τοίχου της νότιας πτέρυγας. Εως 03:28> | | Προπύλαια | | XHD (Hard Drive) | .mpeg | .mp4 | | OA-032.ΠΛ, ΔΙ-62 |
| 2244 | OA-032.ΠΛ | | | | | | | | | | | OA-032, ΔΙ-049.ΠΛ |
| 2245 | KH-024 | 29/5/2012 | Ε' διεθνής συνάντηση για την αναστήλωση των μνημείων της Ακρόπολης | 1η κασέτα απόγευμα 4/10 | απόγευμα 4/10 | | | | Κασέτες ήχου | | | |
| 2246 | KH-025 | 29/5/2012 | Ε' διεθνής συνάντηση για την αναστήλωση των μνημείων της Ακρόπολης | 2η κασέτα απόγευμα 4/10 | απόγευμα 4/10 | | | | Κασέτες ήχου | | | |
| Σύνολο | | | | | | | | | | | | |

Access database including the analog, digital and digitised, audiovisual archive

the archive not only to be accessible and manageable, but also to facilitate the personnel of the Documentation Office to annotate them in the Database. The new codification of the documents included the suffixes .Ψ (digitised), .P (film reel), .ΠΑ (primary footage), .OA (born digital audiovisual file) and also the separation of the files KH (audio cassettes) from KA (video cassettes).

The metadata of the database
Codifying the audiovisual archive was a demanding and complex process as it had to include various types of files, and give emphasis to their correlation, promoting so a twofold aim. On the one hand, as aforementioned, it intended to entirely register and integrate the whole number of analog, digital and digitised documents in the existing database in Access, in order to interlink all the various formats of the documents and to inventory all the various storage areas (a kind of an enriched catalogue), and on the other hand it functioned as an intermediate stage for recording and documenting the audiovisual files, until their selective migration to the central information system of the central database of YSMA (Esma DB).

Migrating documentary information of the audiovisual archive to YSMA’s da-

tabase (Esma DB) will make content retrieval easier and allow its association with other produced sources in order to achieve the best possible documentation of the interventions. Besides, what the Archive essentially offers to the user is an analysis of the content of the digitised material as accurately as possible in order to make searching for information easier; moreover, it offers additional information by exploiting the large amount of material it comprises. It is here where we touch upon the value of the right management of metadata.

The completion of the codification process showed that the new technical requirements of the archive, the different categories of formats, the present extended and complex associations among the documents and the need for a future migration of selected entries to the central database (ESMA DB), have led to the need of redefining the metadata of the documents and the fields of database in Access.

The existing YSMA database in Access was enriched with metadata that follow international processes of modelling, especially for audiovisual material. The metadata are data that describe the attributes of a document and support various functions: tracking, discoverability,

documentation, evaluation, selection etc. The metadata standard DUBLIN CORE was initially adopted for the design of database. In order, though, to cover the new needs of the born digital and digitised documents the extension EBUCORE was used as it is a metadata specification more suitable for audiovisual material. The selection of the new metadata fields happened with regard to the following:

- The entry of the collected body of the audiovisual documents in one single information system.
- The creation of a database that would not only incorporate the older one, but it would also use fields from the central database, so as to be linked with it, acting as its precursor.
- To support and enable the scientific personnel to track, trace, record and document files.
- To enrich and replace metadata in order to cover all the needs of the documents’ various formats, but on the single condition that the fields of database should remain as few as possible to avoid creating a chaotic database filled with documents containing a very large amount of metadata.

Bearing in mind the aforementioned, all the fields of database had to be redesigned. Some fields remained the same, others were replaced, some others changed content. Trial tests on the documentation of various categories were carried out throughout the whole process to find out if the database could cover all the required needs of the files; the conclusions were used to make additional modifications on the fields. After numerous trials the fields, which could sufficiently incorporate all the formats and function both as a storage and inventorying agents and as a documentation instruments, were found.

For the final selection of the fields great importance was given to the associations of the documents among the analog media, as there were many cases where the primary film files (good quality) had been transcribed into cassettes (medium quality). In addition, on content level, it was found that different documents had



Examples of digitised and born digital audiovisual material

become (unedited) part of a final production or of the continuation of restoration works conducted on the same area.

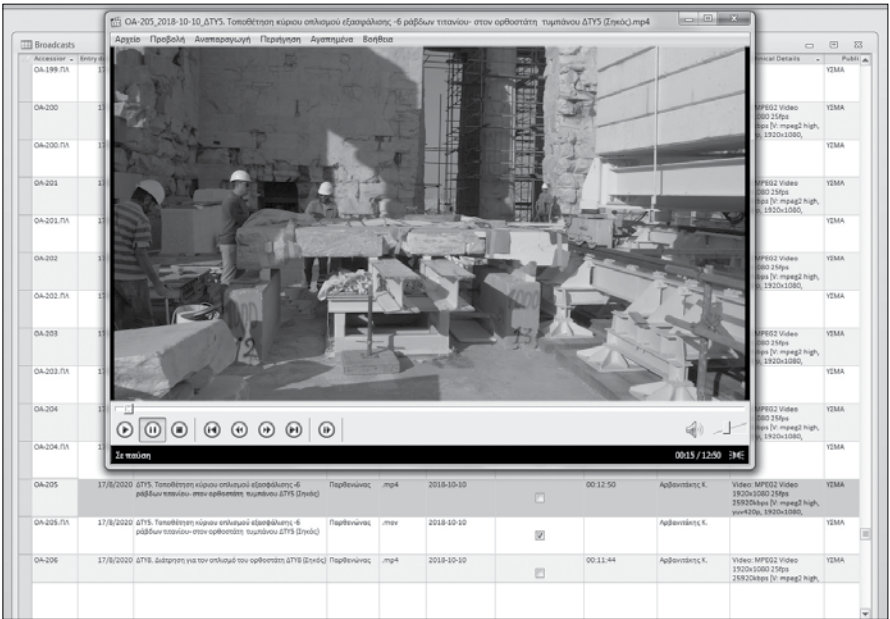
In 2020 inventorying on database in Access started, which until the publication of the present paper, includes about 2000 audiovisual documents.

Future use of the archive
An archive constitutes basically an organic collection of primary (namely raw) recorded information that can be used as material evidence or proof of an activity; in this light, its compilation and preservation can act as a link in the process of recording human history. Digitising archive documents strengthens the role

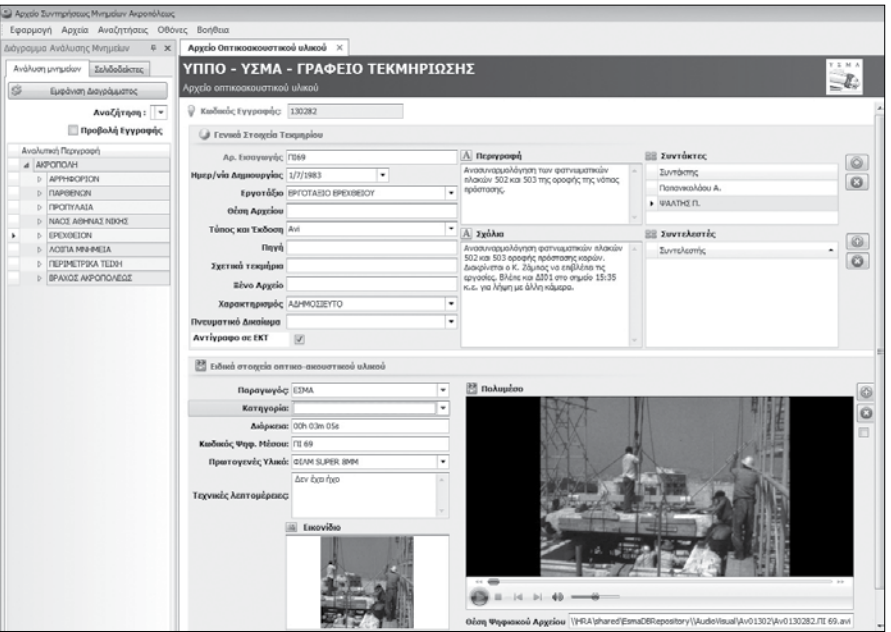
of the archives as cultural and historical documents, contributing so to both its preservation and to a more extended access to archive material. An important success factor that could help the user access the information is looking for is the correct content analysis of the digitised material, which can also enhance the experience by exploiting the maximum of the provided material through the correct management of metadata.

YSMA, having already set strict archive standards for the photographic and drawing archives, applied state of the art standards and paradigms, in both the management of the audiovisual documents and the enrichment of the metadata, in order

to preserve and pass down to future generations the audiovisual archive, which is by itself a valuable documentation tool of the interventions on the Acropolis monuments. Enabling easy access to the archive allows not only the user to study the material, but also deploy it in order to produce new audiovisual works that would appeal to the general public, a factor that will strengthen the dissemination and promotion of scientific information. Given that, it should be examined whether it is possible to utilise YSMA’s audiovisual archive by creating an online repository, so this unique in content archive, which meaningfully, directly and vigorously depicts the history of contemporary restorations on the Acropolis, can become public domain in the world community.



The documentation of the digital audiovisual material in the Access database



The documentation of the audiovisual material in YSMA’s database (ESMA DB)

Stavrina Poulou
Archaeologist
Multimedia Designer
Documentation Office

Cranes, bridge-cranes, lifting/suspended platforms and wheeled machinery used at the Acropolis rock. The technology, since the installation (in 1983) of the first crane (designed by Prof. M. Korres) to the SE corner of the Acropolis rock, has been at the service of culture by transferring and lifting heavy (up to 10tn) loads in order to support the conservation and restoration works at the Acropolis monuments.

The Electro-Mechanical (E/M) installations of the Acropolis Restoration Service include not only the E/M equipment (worksite equipment and marble processing equipment), but also the E/M infrastructure systems (cooling/heating, water supply, sewage, rainwater sewage, heavy current, low current, compressed air, fire protection, lightning protection) that are needed in the worksites as parts of the broader E/M infrastructure systems of the Acropolis archaeological site.

Nowadays, the Acropolis Restoration Service holds:

I. Worksite equipment

- two cranes, one at the SE corner of the Acropolis rock and one (POTAIN MR90) installed at the cela of the Parthenon. The third one, DERRICK, which was placed at the cela of the Parthenon, after being in an incessant operation for 35 years,

- moved (on December 2017) to the Lavrion Technological and Cultural Park, where it is exhibited
- three bridge-cranes, with SWF winches and lifting capacities 12.5, 5 and 3.2 tons
- two lifting platforms
- one suspended platform
- one diesel rough terrain forklift truck (BOBCAT T40140) used at the worksite on the East side of the Acropolis archaeological site (next to Thrasyllou Street)
- one diesel forklift truck (JUNGHEINRICH DFG550s), on the rock
- one agricultural tractor NEW HOLLAND, on the rock
- six oil-free piston compressors (ATLAS COPCO) of 10 and 5 hp
- scaffolding (and their parts)
- pallet trucks and floor cranes
- electrical tools (table and portable)
- 2. Marble processing equipment**
- three copying machines with portable or fixed tables
- three cutting machines, two with discs and one with wire
- one drill

The aim of the Technical Office and E/M Support Team is to ensure the proper, effective and reliable function of the installed E/M equipment, conducting the necessary maintenance works (corrective,

improvement and preventive), supplying the related spare parts and running successful certification inspection (of the equipment), in order to ensure the smooth progress of the conservation and restoration works.

The maintenance works (corrective, improvement and preventive) are carried out either by the E/M Support Team, or by external stakeholders, always following the necessary procedures. The communication and collaboration with all the companies (and their dealers) is crucial, in order to ensure constant and direct access to primary technical information and to ensure that the works are conducted by certified external teams in accordance to specific (and certified) processes. An important parameter for accomplishing the maintenance works (corrective, improvement and preventive) is their cost (the procurement cost of spare parts and the cost of employing external partners). In case that the maintenance cost is evaluated (in relation to the position, age and condition of the equipment) costly, then the Technical Office submits to the Acropolis Restoration Service a detailed, technical/financial report for the equipment upgrading.

In particular, in case of defects/failures that demand quick interventions of corrective or improvement maintenance, the Technical Office identifies, inspects and evaluates the type (and the extent) of the defect/failure while at the same time runs the necessary procurement procedures in order to provide the spare parts, plans, executes and completes (on time) its repair. As all the equipment has to operate properly, in order to support effectively the conservation and restoration works in every worksite, the Technical Office works against time so as to minimise the time needed for the identification, inspection, evaluation and repair of the defects/failures.

To name but a few, we cite three examples of maintenance (corrective, improvement and preventive) for the worksites E/M equipment.



The forklift machine JUNGHEINRICH DFG550s
Photo G. Kehagias, 2019

Corrective maintenance

During the operation of the POTAIN MR90 crane (installed at the cela of Parthenon since December 2017), the operator reported a failure in the movement of the lifting wire rope while choosing specific lifting speeds through the crane's remote control.

The Technical Office and E/M Support Team ran tests on the crane (choosing different lifting speeds), recorded and evaluated the display errors on the Frequency Converter (LEROY SOMER) of the hoisting winch (33 LVF 25 OPTIMA), using the available manuals and technical sheets. The evaluation showed a defect at the crane Encoder as a possible cause for the crane failure (it has to be noted that searching the crane archives, a similar failure had been noticed during the crane installation, back to 2003 that led to the replacement of the Encoder).

At the same time, the recorded data were sent for evaluation both to the manufacturing company of the crane (POTAIN/Manitowoc) and to its dealer in Greece. They suggested as a possible cause for the failure, a defect on the Frequency Converter (whose replacement cost was ten times higher than that of the Encoder).

Finally, replacing the Encoder (as the Technical Office considered that this solution was the most immediate, costless and effective, as a first step), proved to be the



The forklift machine BOBCAT T40140
Photo G. Kehagias, 2019

right action, putting the crane POTAIN MR90 back into operation, supporting the conservation and restoration works at the Parthenon.

The consideration of all the parameters in relation to the relevant costs (procuring spare parts, employing external teams) and the crane archives (service data) that strengthened the Technical Office evaluation, defined the corrective maintenance works that were finally carried out.

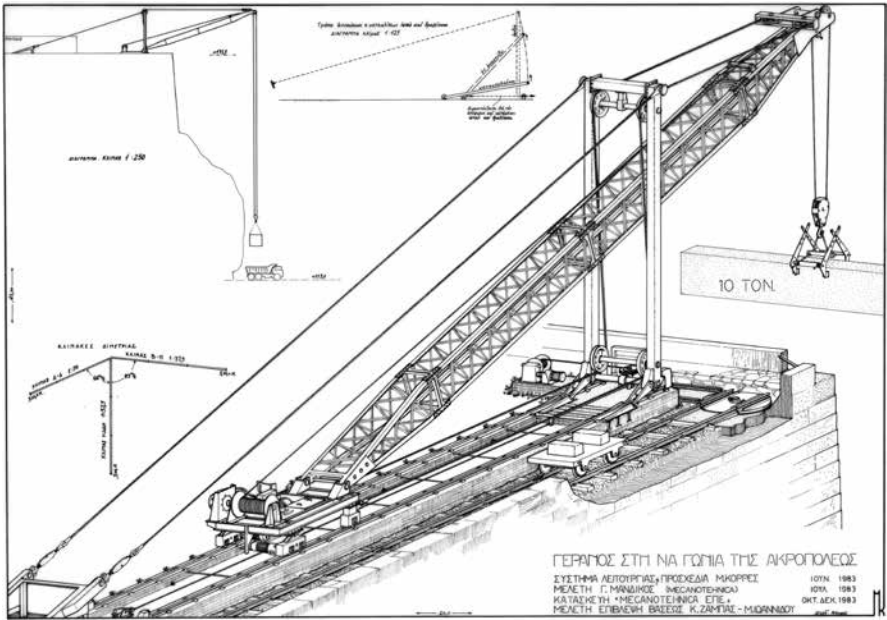
Improvement maintenance

Strofeio (designed by Prof. M. Korres), the rotation and direction-changing mechanism of a low-sided rail wagon that is used for the transportation of materials and equipment from the SE corner of the Acropolis rock to the worksite of the Parthenon, is a practical and functional invention, installed (with the adjacent crane) in 1983.

The most important advantages of its use are, the simple operation (the impact to the loaded wagon and the developing moment of inertia are enough to turn the Strofeio manually, lock and unlock it through a locking mechanism), the bare minimum needs for maintenance (regular cleaning and lubrication of its individual parts) and its small dimensions (diameter: 1.50m, height: 0.18m) considering its position (the SE corner of the Acropolis rock) and the fatigue it experiences through lifting loads.

The extensive damages on many of the Strofeio parts (not only the concreted part but also the rotating one) due to the mechanical stresses they have suffered since 1983, affected its operation (difficulty in locking and unlocking, making the transportation of heavy materials and equipment quite dangerous for the safety of the staff).

The aim of the Technical Office and E/M Support Team was the maintaining and the improvement in the operation of the existing mechanism because of the important advantages that offers (and not its replacement with another mechanism of a different technology – something that was considered by the Acropolis Restoration Service in the past). After identifying and evaluating the damages on the mechanism, the improvement maintenance works were programmed and conducted in situ (in collaboration with an external stakeholder, special-



The crane at the SE corner of the Acropolis. Drawing: M. Korres, 1983



Corrective maintenance works on the rotor mechanism. Photo G. Kehagias, 2019

ised on designing and producing metal components), at the same time that the Acropolis Restoration Service planned restoration works at the SE corner of the Acropolis rock, letting the adjacent crane out of use. Maintenance works were conducted on both of the mechanism parts, the concreted (producing new raceways for the rolling bearings, repairing the central rotation pin, cleaning and painting with special anti-corrosive paint, replacing the 126 (Φ32) rolling bearings) and the rotating one (producing new interlocking mechanisms and new raceways for the rolling bearings, cleaning and painting with special anti-corrosive paint, replace all the screws).

Strofeio is now absolutely functional and safer for the users while its improvement maintenance cost was at least 1/20 of the cost of its replacing (with another of a different technology).

Preventive maintenance

Preventive maintenance is of significant importance, not only for the proper, effective and reliable operation of the equipment, but also for minimising the needs for corrective or improvement maintenance. In most cases, the manufacturing company of the equipment sets out the necessary preventive maintenance works, considering the operating hours and the operating conditions (for example for the POTAİN MR90 crane or the wheeled machinery). In case of custom-made/designed equipment, consisting of single individual parts, the preventive maintenance works are a combination of preventive maintenance works to any of them. Concerning the bridge cranes, the preventive maintenance works on their winches is a combination of works that inspect/evaluate the condition of their metal components.

In detail, the annual preventive maintenance works on the bridge cranes of the worksites, include:

- inspection/maintenance of the trajectory system (engines, gearboxes, breaks, terminal switches etc.)
- inspection/maintenance of the winches, their trolleys and other parts (cable guides, wire ropes, overloading system, load display, brakes etc.)



The crane POTAİN MR90 at the Parthenon. Photo G. Kehagias, 2020

- inspection/maintenance of the other bridge crane components (joysticks, rails)
- inspection of the electrical components and electrical connections
- inspection of the bridge crane's metal body (cracks, deformations, oxidations)
- inspection of the bridge crane's jib inclination

The cost of the preventive maintenance is usually fixed and small, apart from the

case of identifying (during the preventive maintenance works) a defect or failure (at the equipment), so its corrective cost should be taken into consideration.

Regarding the maintenance works, the Technical Office and E/M Support Team has created (the last 3 years), a digital operation and maintenance archive for all the equipment, that includes:

- a list of internal and external stakeholders, manufacturers and dealers
- manuals and drawings
- the preventive maintenance works that the manufacturers set out
- defect/failure history and data (collected during corrective, improvement or preventive maintenance)
- background information on conducting works certifying and inspecting the smooth operation
- spare parts list (based on the operation and maintenance archives)
- photographic documentation of the corrective, improvement and preventive maintenance works.

This digital operation and maintenance archive, beyond the opportunity of a continuous and reliable monitoring of the equipment (by the Acropolis Restoration Service), could be the base for a maintenance software (that could be installed in the future, regarding the conservation and restoration works at the

Acropolis monuments), with all the benefits and further opportunities that offers.

Besides the operation and maintenance of the E/M equipment it is also crucial to sustain the operation and maintenance of the E/M infrastructure/systems (cooling/heating, water supply, sewage, rainwater sewage, heavy current, low current, compressed air, fire protection, lightning protection) of the worksites. The E/M infra-



The bridge crane inside the Parthenon cella

structure/systems of the worksites are part of broader E/M infrastructure/systems of the Acropolis archaeological site. During the last two years, the Acropolis Restoration Service, the Ephorate of Antiquities of the City of Athens and the Central Directorates (Directorate for the Restoration of Ancient Monuments, Directorate of Studies and Conduction of Technical Works in Museums and Cultural Buildings) of the Ministry of Culture and Sports run many projects related to the E/M infrastructure/systems including the documentation, redesigning or upgrading of them in order to operate more effectively while minimising any aesthetic disturbance caused to the archaeological site.

Indicatively the following projects have been either completed or are in progress:

- the analytical documentation (with the related drawings) of 175 electrical boards (central and peripheral) of the heavy current system in the Acropolis archaeological site that includes the rock and the two slopes (north and south) in order to redesign the heavy and low current infrastructure, unitising or removing electrical boards and installing new electrical lines



The bridge crane at the Parthenon worksite

- upgrading the lighting system on the Acropolis monuments
- upgrading the heavy current electrical installations at the Erechtheion area in order to support different needs (worksite needs, security, lighting)
- upgrading the heavy current electrical installations at the Acropolis entrances (main entrance and the entrance from Areopagitou Street) while installing generators to support the use of e-ticket
- upgrading the central electrical board at the old Acropolis Museum (during its restoration) that supports the Parthenon worksite, the crane on the SE corner of the rock and the area's operational systems (lighting, security system)
- upgrading/improving the lightning protection system on the rock
- upgrading/replacing the elevator for the disabled people, on the north side of the Acropolis rock.

As Manolis Korres once said, similar to the unknown of what a surgeon faces while opening a human body, which often shapes the decision about how to proceed, thus on the Parthenon, despite the thorough research, the real condition (therefore the needs for conservation and

restoration) of the architectural members, is revealed during the intervention, affecting (many times) the duration of the works. The E/M installations as well constitute, over time, the "hygienic equipment" that ensures the successful outcome of this critical and demanding process, of conserving and restoring, not only the Parthenon but also all the Acropolis monuments.

George Kehagias
Mechanical Engineer-Museologist
In charge of the Technical Office
and E/M Support Team

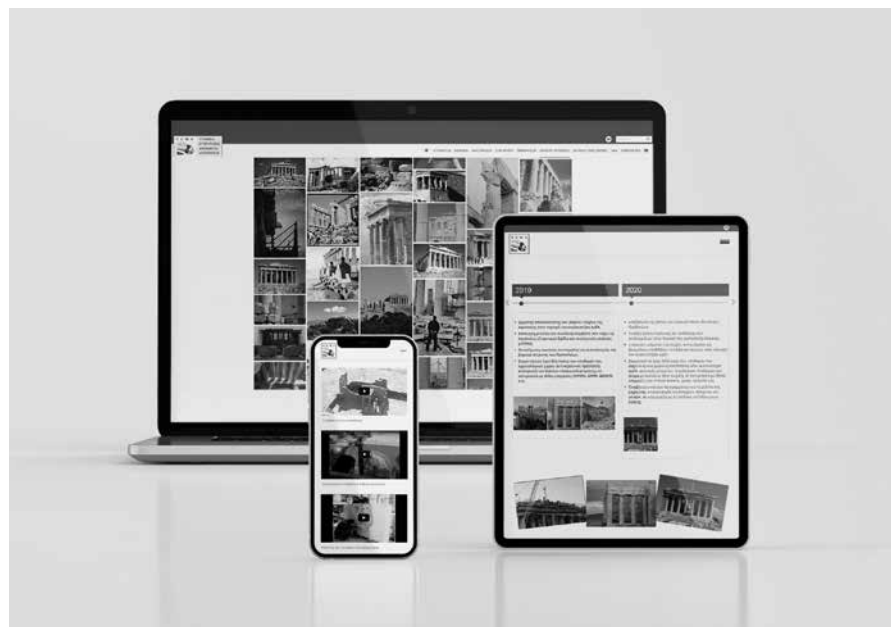
In 2020 the Committee for the Conservation of the Acropolis Monuments (ESMA), the interdisciplinary committee that introduced new scientific criteria for restoring the monuments of classical antiquity, celebrated 45 years since its establishment. Since 1975 ESMA works unceasingly by guiding interventions in the monuments, planning, and promoting research relevant to restorations, organising documentation and supporting dissemination and the educational utilization of the extremely important cultural archive, which is collected from the restoration intervention in the Acropolis monuments.

The period when the Documentation Office and the Department of Information and Education of the Acropolis Restoration Service (YSMA) were planning the celebration events for the anniversary coincided with the advent of the pandemic, a factor that imposed on the Service to change the planned events into digital ones. The digital character of the events, although at the beginning answered to the needs of that time, proved later on to be a really flexible choice as it offered the possibility to access the Service's multiple audiences and thus disseminate its rich archive material to a large number of on-line visitors.

The activities were posted in December 2020 on YSMA's website, under the title "45 years of ESMA. 45 years of works" (www.ysma.gr/en/news/45-years-of-esma/). They are open access actions that allow the public to get to know and access unpublished documents from the history of the restorations, educational digital activities addressing children, parents, guardians and school groups and include an invitation to participate in a photographic exhibition. All the activities we present below, were designed and implemented in two languages, Greek and English, as they target both Greek and foreign audiences that are interested and follow the restoration works on the Acropolis monuments.

Open Access to the archive

ESMA, since its establishment, has pur-



Selected examples from the digital activities of YSMA designed for computers, tablets, and mobile phones. Picture creation: S. Poulou, 2022

sued the goal to provide free and total access to high-quality archive material, which has also been one of the central pillars of YSMA's Documentation Office. Thus, the open access actions were in this regard designed for the scientific and general public, intending to inform and enrich YSMA's website with documents all of which are published for the first time. These included the re-designing of the timeline of interventions, posting films from the audiovisual archive of ESMA/YSMA and displaying all ESMA/YSMA publications in digital form.

More specifically, the timeline of interventions –which had already been included in YSMA's website– was re-designed to allow image uploading and thus, the timeline was enriched with unpublished photographs which illustrate the description of the works that visualise the work description. In this way YSMA provides a concise, codified, and illustrated documentation of the interventions of the Acropolis per year, since the establishment of ESMA. The timeline, as it has been finally designed, allows the visitor of the website to acquire an overall view of the development of the works as well as an understanding of the changes the works have imposed on the archaeological land-

scape. The photographs provide directly and graphically information about the way the works are conducted, the methods used, the people responsible and in general the prevailing atmosphere of the period the photograph was taken. The webpage for the timeline of the interventions was designed by the archaeologist-multimedia designer, S. Poulou and implemented by the archaeologist, E. Petropoulou and the IT technician, D. Iliopoulou.

The design of open access actions allowed to utilise part of the Service's audiovisual material which had already been systematically digitised, codified and catalogued (see relevant article in this issue). From the entire amount of the material ESMA/YSMA chose to make available to the public five films, from their production and more specifically the following: "The rescue of the monuments" by K. Vrettakos, "Parthenon 1991: Conservation of the east facade" by D. Vernikos (1992), "The Erechtheion and Time" by A. Drakopoulou (2001), "The Acropolis Restoration Project" by S. Mavrommatis (2009) and "The Erechtheion, history and restorations" by D. Patrikios (2010). The films had been shown very few times, only at special events organised for the Acropolis works. Their digitisation and posting on YSMA's website and YouTube

channel allowed the public, and especially younger people to get to know aspects of the ESMA's long-term work through the lens of renowned directors. This particular action was designed and implemented by S. Poulou.

The action of openly circulating publications to the public was also developed within the same framework. ESMA, since its establishment, has ensured the publication of approved studies, the proceedings of international scientific meetings and conferences and also the reports of the completion of works. Moreover, in special occasions it publishes anniversary editions and catalogues. Since 2000 it publishes annually "The Acropolis Restoration News", an edition addressing the general public. On the occasion of reaching 45 years of operation, the catalogue of editions was updated and the entire list of publications was posted on the website –the older ones digitised and the more recent ones in their digital form– in Greek and English, for every year of production. In this way the visitor of the website can at any time consult, refer to and even store ESMA/YSMA's publications. The action makes accessible some of the oldest, but fundamental, of ESMA's publications that are now out of stock. The webpage was designed by S. Poulou, while the action was implemented by the librarian M. Maznoki and the Head of the Documentation Office E. Lempidaki.

Digital educational activity

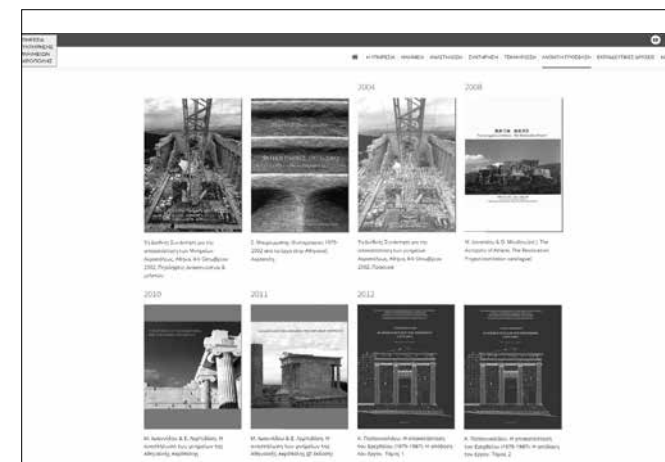
From 1987 onwards, when the first educational programme was organised on the Acropolis, ESMA has shown a steady interest in employing scientific knowledge for the benefit of Primary or Secondary education students. Thus, it was impossible not to include educational actions when planning for the anniversary celebration of the Committee's 45 years. On this occasion the implemented educational units included: "Coffer? What a strange word!" and "Greek columns and column capitals!", which were designed as game-based learning activities that encourage learning through discovery. In addition to providing texts and illustration that promoted interactive playing, the specific educational units were enriched with a variety of educational activities, such as digital games, printable activities and constructions instructions that encourage children to cultivate their digital skills and experientially engage in the educational process. These educational webpages inaugurated on the website the section "Learn, play, create" addressing children, parents, guardians and school groups and they are constantly being enriched. The webpages were designed by S. Poulou, the action was implemented by the archaeologists Ir. Kaimara, A. Leonti and M. Tsiolaki of Department of Information and Education.

A participatory photography action

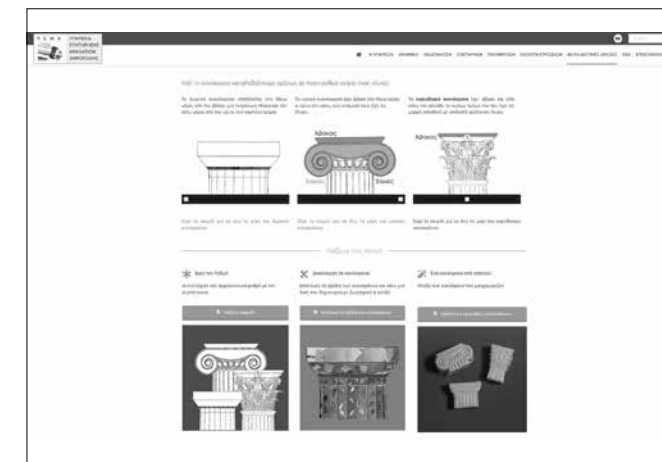
Looking for ways to directly communicate and connect with the public led

YSMA to the design of the participatory photography action: "Acropolis: focusing on the restoration". The aim was to approach the public in an inclusive way, to explore the feelings developed during a visit to the Acropolis and to retrieve memories of the event. The action asked visitors (Greeks and foreigners) and people who work on the Acropolis, to reflect and comment on the restoration interventions in any way they thought appropriate, presenting as such their personal stance towards the Acropolis monuments. The long-term goal was to create an online photographic exhibition that incorporates and promotes all the different approaches to the monuments.

Given the above the photography action was designed and implemented in two stages. During the first stage and after a discussion with S. Mavrommatis, the photographer of the Service from 1979 to 2010, an invitation towards various audiences was designed and published including the terms, conditions, and the technical specifications for the participation. The invitation asked people to send one to five photographs, taken after 1975, focusing on the restoration works on the Acropolis monuments conducted under ESMA's supervision. A small text, a story, explaining the reasoning behind the picture, had to accompany the photographs. A brief caption could also be accepted if it encompassed a small and important story for the photographer. The combination of



Indicative presentation of the digitised publications posted on YSMA's website



Indicative presentation of the digital educational activity "Columns and Capitals!"

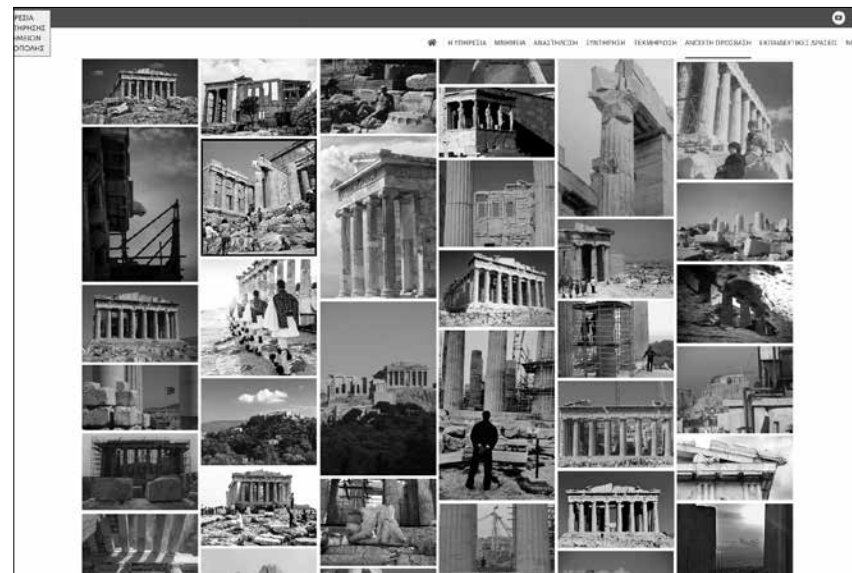
the picture and the text aspired to reveal how people who visit or work at the site interact with the Acropolis monuments. Moreover, the project aimed at bringing to the fore, through a visual dialogue, the different “realities” that are created and experienced in the archaeological site.

The invitation was published on 9.9.2020, on YSMA’S website and remained posted, after extending its deadline to 20.11.2020. In parallel, it was republished in many media, print or digital, in Greece and in the Omogenia, and on the social media. Given the fact that it was the first time that YSMA had addressed an open call to the public, using the participatory design methodology –a complex process that requires appropriate organisation and a well prepared timetable of work– the public’s response could be described as moderate but quite enthusiastic. This conclusion is important as it can help the Service to evaluate the communication channels used for engaging the public in various projects. One hundred and twenty people in total responded to our invitation, from Greece and abroad, (for example, we had participants from Germany, Great Britain, Australia, India, and Korea), sending around 600 photographs accompanied by an equal number of texts.

In the second stage of the photographic action, after collecting the photographs and the texts, the most distinguishing photographs were selected to be posted on the digital exhibition. The selection was made by YSMA’s director, V. Eleftheriou and ESMA’s deputy president Prof. F. Mallouhou-Tufano. Although initially the intention was to select a smaller number of photographs and texts for publication,

applying stricter artistic and technical criteria, the emotional value and significance of the received photographs surpassed our expectations and so we decided to choose one photograph from every participant.

The digital photographic exhibition “Acropolis: focusing on the restoration” which was designed, with special care and excitement, remains online in the section “Open Access” of YSMA’s website. The exhibition composes a multicoloured mosaic of photographic stories that shows snippets from the “daily life” of the Acropolis monuments in the last 45 years. When someone clicks on a photograph, then the accompanying text appears as a caption.



Indicative presentation of YSMA's digital photographic exhibition entitled "Acropolis: focusing on the restoration"

The photograph and the text compose a dynamic and inseparable unit that ranges from a simple, but not negligible, description of the picture, which often reveals forgotten information from the time it was shot, to a touching manifestation of emotions. The monuments and their restoration works are always present, either as the main subject of the photographs, or as a hint in the background.

The exhibition acquires its dynamics from the presentation of multifarious images –artistic photographs, recording photographs that function as documents

and souvenir photos that cover the period of 45 years that ESMA is in operation. In this light, the exhibition established a conversation between the participants, during which the monuments, through diverse cultural significations, become the central meeting point and a reference to memory. The photographic exhibition, within its scale, reveals the bonds people develop with the monument and the way these bonds are strengthened after their departure from the archaeological site. This photographic participatory action was designed and implemented by the writers of this article.

In conclusion, we would like to stress that the digital actions “45 years ESMA. 45 years of works” have given the opportunity for opening new sections and possibilities for the website of the Service, which by following contemporary trends in disseminating information and promoting culture online, is being enriched and renewed, in order to become a point of reference for both the scientific and the general public, of all ages. In this way, YSMA not only succeeds in reaching out to its audience, but also in developing this audience, contributing as such to a meaningful relationship between the public and the monuments.

Stavrina Poulou
Archaeologist
Multimedia Designer
Evi Petropoulou
Archaeologist

Documentation Office

Every year, as in the years included in the present Newsletter, YSMA’s activities were not restricted in the field of restoration but, as we analyse further down, were expanded in the areas of disseminating scientific information and communicating with the public. In particular, during the year 2020, the restrictions imposed by the pandemic and the created unprecedented conditions led the people of YSMA to devising online activities with the aim of increasing public engagement and communication.

Educational activities

During 2019 and the first quarter of 2020, the Department of Information and Education of the Acropolis Restoration Service (YSMA) planned and conducted a variety of educational activities aimed at students, teachers, families, and the general public. In the second quarter of 2020 all activities involving the need for physical presence had to stop since the measures against covid-19 came into force. All the planning and designing of activities during the remaining part of the year focused mainly on implementing online activities.

Specifically, until the second quarter of 2020, inside the Acropolis Museum 3,550 Primary and Secondary students attended educational programmes whose subjects focused on the Parthenon sculptures, the ancient temples, and the Olympian gods. In addition, the two-day educational event “Acropolis and Restoration”, where 350 students of the 1st Lyceum coming from 14 schools of Attica participated, was organised for the fourth time. The students, who participated actively in laboratories conducted on the Acropolis with the guidance of our Service’s specialised personnel, had the opportunity to become acquainted with the important and up-to-date technical work that is being carried out on the monuments of the rock (29.3.2019 and 1.4.2019). In addition, in 2019 the Department participated in the celebration of the “European Heritage Days” by preparing the educational programmes “The children are playing....on the Acropolis” for Primary School children. The students were shown around the rock, learnt about the games found engraved on the monuments, played, had fun, and compared the ancient

games with modern ones by using specially made copies of these games. Finally, the educational programmes “Festive Stories”, designed for children between the ages of 6-11, were especially prepared for the Christmas events organised by the Museum. The children learnt about the festivals of Ancient Athens and after a brief tour in the exhibition galleries they decorated the Museum with handcrafted ornaments they had made. The educational activities were organised together with the Archaeologists-Hosts of the Museum.

The museum kits of the Department, used by 8,500 students around Greece, contributed to making its activities known and popular. In addition to the above, the educational material designed for families, created in collaboration with the Acropolis Museum, is estimated to have been used by 4,000 Greek and foreign families. In the same year, the theme-based activities of the Museum were enriched with two new family trails for the young visitors, aged 8 and above. The first family trail called “Chisel and Memory: the contribution of marble craftsmanship to the restoration of the Acropolis monuments” assists the young friends of the Museum to tour around the homonymous photo exhibition with the help of Simos, a marble technician who worked on the Acropolis. Thus, they get to know not only the most important parts of the marble technicians work, but also the

difficult, yet fulfilling moments of their daily work at the worksites. The second family trail: “A special day at the Acropolis Museum” was created on the occasion of the Museum’s tenth birthday. The children have to identify 10 exhibits inside the Museum galleries, study them and then draw their own greeting cards that they send to the Museum.

The teacher education seminars continued till March 2020, and the online applications designed for teachers and the public were visited by about 45,000 people in



Exploration leaflet for children and parents



Educational programme “Acropolis and Restoration”

2019, and nearly 100,000 in 2020. The reason for this sharp increase in the number of visitors could be the renewed public interest in digital applications and also because the online activities planned by the Department of Information and Education were greatly enhanced mainly by enriching the Repository containing educational material for the Acropolis (<http://repository.acropolis-education.gr>) with new lesson plans, printouts for school groups and presentation material. In parallel, on the occasion of the 45 years since the foundation of ESMA, the Department of Education collaborated with the Documentation Office for the design of two new online activities for children, parents, and school groups, who are willing to experiment, play and create inspired by the Acropolis monuments. The first activity “Coffers? What a strange word!” and the second “Greek columns and column capitals!” (www.ysma.gr/en/educational-actions/lets-learn-play-and-create/).

Finally, the Head of the department Ir. Kaimara and the archaeologist A. Leonti participated in the two-day conference “Cultural Heritage Studies for Children 0-18” organised by the University of Koç in Ankara on 14-15.11.2019. Their paper’s title was: “The educational activities of the Acropolis Restoration Service”. A workshop presenting at length the content of four museum kits was organised during the same conference. The proceedings of the conference were published in 2020.

A photographic exhibition

One of the most fascinating moments of 2019 was the opening of the photographic exhibition “Chisel and Memory” in the Acropolis Museum, which had been proposed by the Director of YSMA, V. Eleftheriou and Professor D. Pandermais, the President of the Acropolis Museum Board. The exhibition, after its successful

running in Corfu, Mytilene and Thessaloniki, was transferred to the Acropolis Museum, where it was mounted in a completely new design in the temporary exhibition gallery. In this new exhibition large prints dominate the space by covering entire walls where the visitor feels as if transferred to the worksite observing closely the works. In addition, the exhibition included archaeological and historical documents that shed light not only to the techniques used in the restorations on the Acropolis, but also to their history.

On the occasion of the exhibition YSMA’s



The exhibition “Chisel and Memory” in the Acropolis Museum. Photo T. Souvlakis, 2019

Documentation Office produced the film “Short stories of restoration”, directed by K. Arvanitakis. The film includes snippets taken out of interviews from marble technicians who have worked for many years in the restoration works on the Acropolis and film extracts from YSMA’s archive. The members of the staff responsible for the interviews and the selection of the material were the archaeologists E. Petropoulou and S. Poulou, while V. Eleftheriou was in charge of the scientific editing of the whole project. The marble craftsmen M. Bon, G. Desypris, K. Tsirindoulakis, G. Angelopoulos and S. Kardamis appear in the film.

The opening of the exhibition took place on 10.6.2019 at the amphitheatre of the

Acropolis Museum. The keynote speakers of the event were, Professor D. Pandermais, the President of the Acropolis Museum Board, Professor M. Korres, the President of ESMA, V. Eleftheriou, the Director of YSMA and the former Minister of Culture, M. Zorba. After the talks, M. Korres guided around the exhibition the honorary guests who really enjoyed the description as his rhetorical skills, eloquent speech and broad knowledge made it a unique experience. The catalogue of the exhibition, which had been printed by YSMA, was offered to that day’s guests.

In parallel with the exhibition at the Acropolis Museum, copies of the photographs were also exhibited in other countries. In particular, from 19.2.2020 to 20.3.2020 the exhibition was hosted at the patio of the monastery of San Domenico, in Taranto, Italy. The show was organised by the Polytechnic University of Bari (School of Architecture) in collaboration with the Ephorate of Antiquities of Brindisi, Lecce, and Taranto. The exhibition, with the care of Professor M. Livadiotti was part of the events planned to celebrate the transfer of the School’s headquarters from Bari to Taranto. Present in the

opening of the exhibition, which took place on 19.2.2020, were V. Eleftheriou and Professor F. Mallouchou-Tufano. The film “Short stories of restoration”, with Italian subtitles, was also shown in the event.

At the end of the same year, from 27.9.2020, to 3.1.2021, the exhibition was hosted in the Museum of the city of Chengdu, in China. The transfer of the exhibition was an initiative of the Greek Ambassador in China, G. Iliopoulos and was mounted with the joint action of YSMA, the Greek Embassy at Beijing, the Office of Foreign Affairs of the Municipality of Chengdu, and the Museum of Chengdu. The exhibition was exceptionally assembled and displayed and two columns from the 3D digital model of

the Erechtheion were printed to enrich the presentation. The opening took place on 27.9.2020, in the presence of the Greek Ambassador.

A Publication

YSMA printed the catalogue of the exhibition at the Acropolis Museum before the opening. The publication includes all the 108 photographs of the exhibition organised in thematic groups (self-denial, labour, collaboration, zeal, pride, companionship), a preface by Professor M. Korres and introductory notes by E. Lempidaki, E. Petropoulou and V. Eleftheriou. The archaeologist S. Poulou was responsible for designing the explicit catalogue while E. Petropoulou was the editor. The photographer T. Souvlakis was responsible for editing the photographic material. Dr E. Lempidaki, the Head of YSMA’s Documentation Office, was the one who supervised the whole project. The catalogue was distributed to all the people who attended the opening of the exhibition, to YSMA’s employees and to anyone who was interested in collecting it from our offices.

Presentation on ERT TV channel

In February 2019 an episode of the TV show on ERT “Οι Δρόμοι της Ανάπτυξης” (The Roads to Development) was filmed on the Acropolis. The show presents projects that are implemented in Greece and co-funded by the European Union, which

deal with social, infrastructure, cultural and other developments. This episode concentrates on the restoration works on the Acropolis and includes interviews with the Heads of YSMA’s Departments and footage taken at the worksites and the laboratories of the Service. The interviews were taken from the following members: YSMA’s Director V. Eleftheriou, the Head of the Parthenon Restoration works R. Christodouloupoulou, the Head of the Walls Restoration works D. Michalopoulou, the Head of the Surface conservation Office E. Aggelakopoulou, the Head of the Documentation Office E. Lempidaki, and the Head of the Department of Information and Education Ir. Kaimara. The show was broadcast on ERT on 9.6.2019; the episode’s title was: “Ακρόπολη: έργα συντήρησης και αποκατάστασης” (Acropolis: Conservation and restoration works).

Participation in an Archaeological Film Festival

YSMA, accepting the relevant invitation, participated in June 2019 in the International Archaeological Film Festival MAIA 2019, in Sao Paolo, Brazil. The Festival was organised by Museu Imaginario and SESC, a non-profit organisation, from 24-26.6.2019 under the auspices of the Greek Consulate and other interested parties. During the Festival eight locations of historical/archaeological interest were presented and seven films were shown. YSMA was represented by V. Eleftheriou who gave a lecture on 24.6.2019 entitled “Landmark of Athens and the world: The Acropolis, its cultural context and their protection”. Although the presentation focused on the restoration of the Acropolis monuments, it also mentioned wider issues from the architecture of the Athenian city centre to its urban planning. The film “The restoration of the Acropolis monuments: snapshots from the works, 2011-2013”, produced by YSMA, was shown with English subtitles at the end of her talk.

During V. Eleftheriou’s stay in Sao Paolo, Brazil, the Consul General of Greece, S. Chourmouziadis, took the initiative to organise two presentations regarding the Acropolis works. The first talk, given on 26.6.2019 at the University of Sao Paolo

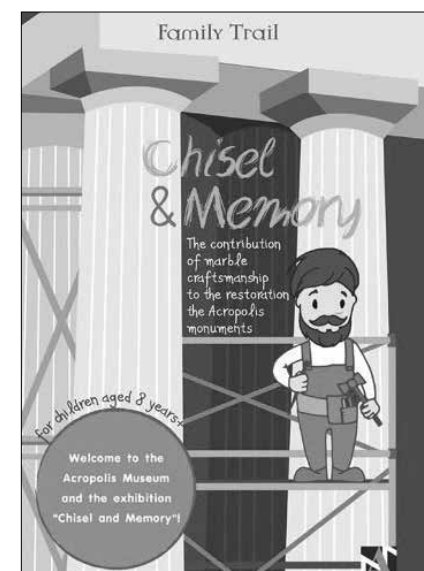


The catalogue of the exhibition “Chisel and Memory”

(USP), was entitled: “The Acropolis of Athens: completed and future restoration projects”. The second, entitled “Η κατασκευή του Παρθενώνα, όπως μας αποκαλύπτεται κατά τις αναστηλωτικές εργασίες” (The construction of the Parthenon as it is being revealed during the restoration works), was given at the Centre of Hellenic Studies “Areti” in Greek and interpreted in Portuguese by Ms E. Sazali. After the lecture, the members of the Greek community that had attended the meeting asked questions from V. Eleftheriou and expressed their gratitude for the opportunity they were offered to be informed about the progress of the works on the Acropolis.

Collaboration with the Herculeum Archaeological Park

At the end of 2019, the Director of YSMA agreed to the suggestion of the Italian School of Archaeology at Athens to instigate collaboration between YSMA and the Herculeum Archaeological Park. It is an archaeological site with unique characteristics, not only because of the archaeological remains, but also because of its management model that has been recently put in use. The collaboration was established on the understanding that the scientific personnel of the two Services would benefit if they exchanged work practices, mainly those regarding the monuments’ conservation and the use of new technology. As a result, in a workshop conducted on Friday 1.11.2019 at the Italian School of Archaeology at Athens, the two parties conversed on the theme of “The use of modern technology for the protection of monuments”. During the workshop the Director of the



Leaflet for children and parents produced by the Information and Education Department

Herculaneum Archaeological Park, Dr F. Sirano, and YSMA's Director, V. Eleftheriou, presented a thorough analysis of the conservation problems both sites face and also the way modern technology can be used to treat them. People who also attended the meeting were the architects P. Pesaresi and A. Dibenedetto, on behalf of the Italian School, the Heads of YSMA's Offices R. Christodouloupoulou, D. Michalopoulou, E. Aggelakopoulou, E. Lempidaki, E. Sioumpara and Ir. Kaimara, and members of its scientific personnel K. Karanasos, D. Mavromati and E. Petropoulou. After the workshop the Italian participants were guided around the Acropolis works where they had the opportunity to have a first-hand experience of the works. The visitors were also informed about YSMA'S education programmes and matters concerning the documentation of the works on 30.10.2019. The collaboration is to continue with a series of seminars in Athens and Herculaneum.

Guided tours

In an effort to inform the public about the works of YSMA, V. Eleftheriou organised guided tours for the members of the Friends of Acropolis Society, who are ardent supporters of the works conducted by the Service. The guided tours took place on 15 and 16.10.2020 and were really appreciated by the participants as the chance to engage in a group activity was really valued during the pandemic.

On 17.6.2020 another guided tour on the Acropolis monuments was organised by YSMA's Director; the tour attended members of the bodies that represent Greece in



A guided visit around the Acropolis works of executive members from the Archaeological Park of Herculaneum. From the left: A. Dibenedetto, F. Sirano, K. Karanasos, P. Pesaresi, R. Christodouloupoulou and V. Eleftheriou

the programme SCIENCE (Spaceborne SAR Interferometry as a non-invasive tool to assess the vulnerability over cultural heritage sites). During the tour around the archaeological site the participants had the chance to discuss with YSMA's scientific personnel matters concerning the structural integrity of the monuments and the condition of their geological substratum.

Lectures-publications

The following section includes the lectures and publications of YSMA's personnel in the years 2019 and 2020. It is of course obvious that during 2019 there are more activities as in the following year the imposed restrictions created unprecedented new conditions.

The Director of YSMA, V. Eleftheriou,

except for her participation in the above-mentioned activities, taught in the postgraduate programme "Architecture and Museology" of Accademia Adrianea di Architettura e Archeologia, which occurred in Athens on 11.2.2019. The topic of her lecture was "The restoration of the Acropolis monuments and the documentation of the project". The architect Dr K. Karanasos also participated in the same seminar by giving a talk on the current interventions on the Propylaea. In the following month, V. Eleftheriou participated in a seminar organised by the Association of Greek Archaeologists "Eos" on the subject of "Η προστασία της πολιτιστικής κληρονομιάς μπροστά στην ψηφιακή πρόκληση: τομείς παρέμβασης και διάδρασης" (The protection of cultural heritage responding to digital challenge and the possible areas for intervention and interaction) on 30.3.2019 at the Acropolis Museum. The title of V. Eleftheriou's paper, which has been very well received, was "Σύγχρονες μέθοδοι γεωμετρικής τεκμηρίωσης στα έργα αποκατάστασης των μνημείων της Ακρόπολης" (Contemporary methods of geometric documentation on the restoration works of the Acropolis monuments). In May later on the same year (11.5.2019), she accepted the invitation of the Association "Architecture Restaurare. Archeologie (ARA)" and took part in the annual (20th) Symposium organised

in Bucharest, Romania. The title of her paper was "The restoration of classical antiquity monuments in Greece during the last twenty years".

Because of the established collaboration between YSMA and the Polytechnic University of Bari, employees of the Service took part in a restoration seminar organised by the Scuola di Specializzazione in Beni Architettonici e del Paesaggio, on 14-16.5.2019 at Bari. V. Eleftheriou gave a lecture on the "Restoration of the ancient monuments of Greece. General and specific issues: the case of Lindos". Dr K. Karanasos participated in the same seminar as well by giving a lecture on the current interventions on the Propylaea. In the year 2020 the restoration seminar was conducted online from 7 to 9 of October. V. Eleftheriou gave two speeches, "The current restorations on the Acropolis of Athens" and "The restoration on the Acropolis of Lindos", whereas K. Karanasos gave a lecture focusing on the restoration of the Propylaea and the Parthenon north wall.

Finally, V. Eleftheriou in collaboration with Dr E. Lempidaki and Ir. Kaimara published their article "Forty years in engaging the public with the restoration of the Acropolis of Athens" in the volume "Material Cultures in Public Engagement. Re-inventing Public Archaeology within Museum collection" (2020).

K. Karanasos, apart from the lectures mentioned above, participated in the 5th National Conference of Restoration organised by ETEPAM (10-12.1.2019). The title of his paper was "The ancient monument after the restoration. Minor or drastic changes of its known image as a result the intervention: the case of the Propylaea of the Athenian Acropolis". The architect Dr E. Labrinou attended the same conference with the paper "Nikolaos Balanos, the first modernist restorer". Both papers were included in the conference proceedings.

During 2020 K. Karanasos gave three online lessons/lectures about the restoration of the Propylaea and also about the restoration of



V. Eleftheriou with members of the bodies participating in the programme SCIENCE, during a guided tour at the Acropolis

the Parthenon north wall. Specifically, on 22.5.2020 he gave an online lecture to students of the Department of Conservation of Antiquities and Works of Art, University of West Attica, on 27.5.2020 he gave a lecture within the context of the 18th Premio Piranesi di Accademia Adrianea de Architettura e Archeologia and on 30.9.2020 he gave an online lecture to the students of the School of Architecture of the University of Chieti-Pescara.

The architect V. Manidaki participated in the conference "From Kallias to Kritias: Athens in the second half of the 5th century B.C.", organised by the American School of Classical Studies at Athens (6-8.6.2019). The title of her paper was "News from the Parthenon cella: the question of an inner frieze".

The Head of the Office for recording, inventorying and classifying the scattered architectural members, Dr E. Sioumpara contributed to the scientific dialogue with three publications in the year 2019. Her paper entitled "Constructing monumentality at the Athenian Acropolis in the 6th c. B.C.", which was presented in the conference "Rethinking Athens. The polis before the Persian Wars" (Munich, 23-24 February 2017) was published in the proceedings of the conference. She also co-authored with the archaeologist N. Papazarkadas the article "Η στήλη της Χαλκοθήκης: νέο

θραύσμα της IG II2 120+1465" (The stele of Chalkotheke: the new fragment IG II2 120+1465) that was published on HOROS journal. Finally, her paper "Managing the debris. Spoliation of architecture and dedication on the Acropolis after the Persian destruction" was published in 2019 in the proceedings of the conference "From Hippias to Kallias. Greek art in Athens and beyond 527-449 BC" (Athens, 19-20 May 2017). She also edited the proceedings together with Professor O. Palaggia. Moreover, she presented two papers: the first one was entitled "The area of Chalkotheke on the Athenian Acropolis during the second half of 5th c. BCE" and was presented in the International Conference "From Kallias to Kritias. Athens in the second half of the 5th c. B.C.", while the second one was entitled "Die Chalkothek auf der Athener Akropolis und die steinernen 'Jahresbilanzen' der attischen Demokratie" (The Chalkotheke on the Athenian Acropolis and the stone "annual accounts" of the Attic democracy) was presented on 9.12.2019, at the Institut für Klassische Archaeologie of the Goethe University.

Evi Petropoulou
Archaeologist
Documentation Office



V. Eleftheriou with the organizers and speakers of MAIA 2019. On her left, S. Cordeiro, main organizer of the Festival



Nick Bourdaniotis, visitor | 2017



Eric Shur, visitor | 2020



Kostas Dais, employee YSMA | 2003-2012

Visit the digital exhibition:
www.ysma.gr/en/open-access/focusing-on-restoration/

News Letter of the Acropolis
 Restoration Service of the
 Hellenic Ministry of Culture
 and Sports

Editor:
 Acropolis Restoration Service

Editing:
 E. Petropoulou

English Translation:
 A.M. Hadjistephanou

Layout:
 J. Topalidi

Published by:

 **Pressious** Arvanitidis*
Print your mind

www.pressious.com



Co-financed by Greece
 and the European Union



The Acropolis Restoration Service
 10, Polygnotou Street,
 GR- 10555 Athens
 Tel.: 210 32 43 427
 Tel./Fax: 210 32 51 620
 e-mail: ysma@culture.gr
www.ysma.gr

©YSMA, 2023
 ISSN 1790-2665