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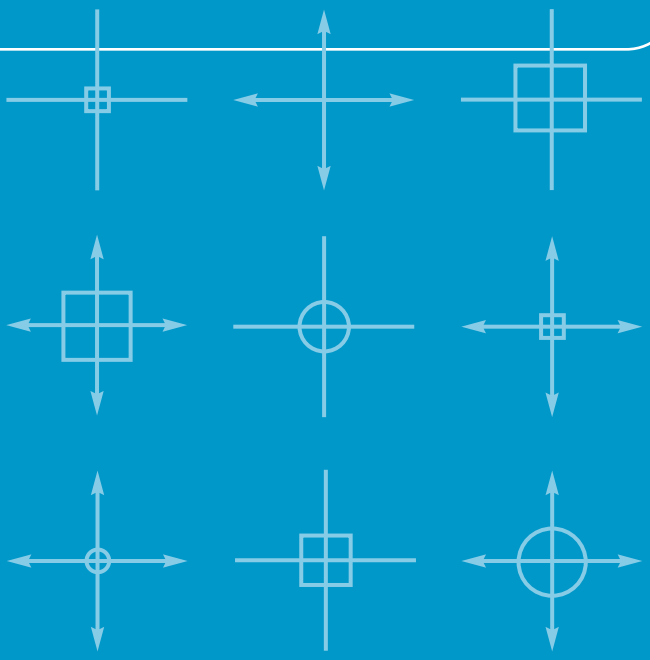

STADT ARCHÄOLOGIE WIEN

CHNT 18 Proceedings

# The Church of Meryem Ana in Göreme, Cappadocia

## Correct documentation for a meaningful heritage at risk

Maria ANDALORO[1] | Tatiana PIGNATALE[2] | Giorgio VERDIANI[2]

[1] Dipartimento di Scienze dei Beni Culturali,Università degli Studi della Tuscia, Viterbo, Italy | [2] Dipartimento di Architettura, Università degli Studi di Firenze, Italy

**Abstract:** In the deep core of Turkey, in Cappadocia, the Meryem Ana church in Göreme, is a meaningful place, rich of suggestions, it is carved in an emerging peak, it faces on the “valley of the swords” 25 meters high over the area where the valley becomes narrow. It’s a small church, but enriched with wonderful mural paints, showing the stories from the Bible about the mother of Christ Mary. The main problem of this church is the large crack dividing in two parts the whole structure, threatening almost the whole church. Other parts of the cave system are already gone lost and the access is done passing through the remains of tunnels and small openings. The water passing by the large crack has partially damaged a large area of the mural paints cancelling their colours. So while our mission was visiting the area during September 2012, it came out clearly that there was no time to lose and our group has operated the 3D laser scanner survey of this monument, finding the needed time in an already very dense agenda. The survey work was planned in three main solutions: photographic survey, laser scanner survey, panoramic photos survey. The results are quite impressive, because they allow reading quite clearly how dramatic is the condition of the crack and to read the extension of this imminent disaster. But at the same time the digital survey is also the right base to start projecting possible interventions on the church and its mural paintings. The possibility to carry into the whole work in a very short time according to the possibilities of the digital tools, showed how a correct documentation can be done also in emergency situations allowing to preserve the status of a monument reducing the risk of its total loss.

**Keywords:** modelling, rupestrian, Turkey, digital survey, heritage at risk

### The rupestrian heritage in Cappadocia

Cappadocia is located in the center of Turkey, in an area of volcanic origin that with time has been excavated and eroded until it became an extraordinary landscape. Today this place looks stunning to the eye of the visitors: the particular asset of the natural appearance, suggesting an organization based on "built" elements has certainly stimulated the first inhabitants of these areas and the long line of their successors, who have continuously carved and excavated the rock masses creating shelters, stores, homes, churches, castles, farms and entire cities. So the rock has been weakened and crumbled and the whole of the excavations, while richly defining the territory have accentuated the degradation and the natural wear of the material, collapsing and transforming interiors into façades, showing beautiful details in the process of dissolution: a rich collection of fleeting wonders. The assets of Cappadocia today appears intended for a broad loss, in certain parts the rupestrian monument are well preserved, in other parts they are abandoned

or overloaded by admiring tourists, this whole patrimony appears only partially preservable, and therefore it is even more exceptional in its late phase. The long-time rupestrian architecture time has passed? It remains a monumental step, the exceptional resonance and vision, the intersection of an incredible nature with amazing choices, which in their own time are certainly appeared logical and decisive. In a place that does not allow the fear of closed spaces and does not allow the fear of open spaces, offering the both of them continuously and savagely.

### The Church of Meryemana in Göreme

The Meryemana church, commonly defined as Göreme 33, is carved, together with a small monastic complex, in an emerging peak overlooking the valley of Kiliçlar – the Turkish name means the “valley of the swords”- from a 25 meters of high over the area where the valley becomes narrow. Here the fertile area rich of cultivations leaves the space to hard stones and high natural walls, where a feeble river has sculpted this valley. The path to reach the church is not easy, the only available passage crosses some rupestrian rooms with ruined fronts, where the visitor sometimes has to pass crawling on his knees because of the small size of the openings, and then reaches the plan space containing the entrance of the Church. Commonly the passage is not open to the public; a small gate closes one of the narrow openings leaving no possibility to continue the visit. The rooms giving the access to the church were separated by numerous rooms connected one another, and there are still the remains of a millstone door. Arrived at the entrance it is possible to notice that it is characterized by the typical horseshoe arch, which was once enriched with wall paintings. The paints are mainly dedicated to the narration of the life of St. Mary and all the biblical events connected to her figure. The architectural typology of the church is different from the other monuments of the area for the presence of a transverse nave blanket of two barrel vaults of different sizes, without support in between. The sequence of spaces shows clearly the complex development of the church across time, with some quite aggressive intervention, like the connection with the room of the tombs which has altered and destroyed a part of the original mural paints. The whole space is dimensioned in small proportions, but it has a very impressive effect on the visitor (fig. 1), the rich colours, the articulated shapes, the sequence of levels and a certain “sense of drama” capture the eyes and generate a strong sense of admiration. The bema is elevated on three steps, and it was originally separated through a carved iconostasis with six arches and five columns, but two columns get lost and so the large missing part creates an asymmetric perception of the church emphasizing the value of the remains. Besides this partially fallen and destroyed colonnade there are a cross-corridor and apses. Only two of the three original apses are preserved, the one on the South side is almost completely disappeared and a large opening toward the valley allows an impressive view toward the opposite peaks. Beneath the right part of the bema, there are other two main rooms excavated down the peak, they are structured one over the other, probably they were carved in different phases and were connected with wooden staircases which now is lost. For this reason the two lower rooms are accessible only “jumping” down, but they are not that tall and they can be easily accessed. The real risk is due to the fact that all the bema and its lower rooms are beyond the crack dividing the church in two parts, the whole crack develops all along the vaults and the vertical walls, and interests the pavement too (fig. 2). Only a

length of half a meter separates the two extremes of the crack on the floor. So any walk done on this side can be considered dangerous for the structure as well for a visitor.

## The digital survey of the Meryemana church

During the survey mission in September 2012, it came out clearly how dramatic was the conditions of the Meryemana church and that there was no time to lose waiting a further occasion to take its survey. After a first reconnaissance visit and some quick planning our group has operated the 3D laser scanner survey and the panoramic shooting of this monument, finding the needed time in an already very dense mission agenda. The survey work was planned in three main solutions: photographic survey, 3D laser scanner survey, panoramic photos survey. Just before starting to operate with the 3D laser scanner, we took time to clean up the crack on the ground, while it was filled with dust, pebbles and stone fragments, so it was not easy to see it in its extension on the ground (thus, as it is possible to see from the figures 2 and 3 its presence is quite dramatic all over the walls and the vaults). Starting taking the scans, a particular attention was given in placing the scanner unit in good alignment with the crack, allowing the laser to enter has much as possible along the separated sides of the stone. The results coming out from the scans are quite impressive, because they allow to read even more clearly how tragic is the condition of the crack and to read the extension of this imminent disaster.

The possibility to complete the whole work in a very short time according to the possibilities of the digital tools, showed how a correct documentation can be done also in emergency situations allowing to preserve the status of a monument reducing the risk of its total loss. The whole digital survey campaign was a very expeditious operation, there was not a long time available and the disquieting condition of the church made prefer to remain in the area for the minimum time needed to complete the operations. The survey was completed in the time of a morning, taking 36 single scans with a variable density between 1/5 and 1/8 resolution according to the Cam/2 Faro settings, almost all the scans taken inside the church were fully panoramic and were enriched with coloured information using the built-in scanner camera. Because of the high danger condition, the scans taken in the lower spaces beneath the bema were only few and not enough to fully cover all the surfaces of these rooms. The need to jump down this lower part and the not easy escape from these rooms were enough to make prefer taking only some scans from this part of the church. All the external scans were taken without picture mapping, because of the absence of mural paintings and to reduce to the overall working time.

Even if the main task of this survey was the documentation of the main church and the quality of the scans was calibrated on this result, the various scans took enough of the surrounding environment to get interesting information about the shape of the peak, the elevation of the church from the ground at the bottom of the valley and and about the stone volume around the church. In parallel with the scans some photographic panoramic shooting were done to have a high quality and versatile image of the state of the church at the time of this digital survey. These shots were taken using a manual control panoramic head and a 10Mp Digital SLR. A secondary photographic campaign was taken, using various cameras, on all the main details and trying to catch the specific characteristics of this architecture.

It is important to underline the fact that, during the survey campaign 2013, a more extended 3D laser scanner survey of all the external areas was done, allowing to complete most of the external surfaces of the whole peak and creating the conditions to better interpreter the state of the crack menacing the church (fig. 4). The alignment of all the new 3D scans with the previous survey campaign was done using morphological references all around the area, the meaningful aspect of the stones and the overall short time between the two campaigns allowed a good result in the global alignment.

### 3D data treatment and analysis of the gathered information

For the dataset coming from the Meryemana church it was choose a very common and well consolidated approach. Immediately after the completion of the alignments, the pointclouds where used to operate useful "virtual surveyor" measurements, in this way it was immediately possible to better understand the disposition of rooms, the distance between elements and the differences of levels between the excavated rooms and the landscape nearby. In general, a better reading of the balance between natural environment and architectures was done, obviously, in this virtual space; it became possible to take measurements even from all the inaccessible areas (top of peaks and very dangerous slopes).

The following passage was the production of a set of 2D representations starting from the extraction of high resolution bitmap from the orthographic view of the aligned pointclouds (fig. 5), these images, once scaled in the CAD software, were used as bases for classical drawings. Even if this processing is time consuming and creates useful but not impressive representation, it is important to remind that this kind of drawing is highly meaningful for real analysis and that the process of preparation and drawing in itself is a meaningful process of understanding and reading. This was done to create quickly a classic documentation of the whole settlement. When the whole set of pointclouds was optimized, it was then simplified and used as a base to create a surface model of this rupestrian architecture. Even if the 3D Laser Scanner has been used to take also the pictures in almost all the scans, to reach a better and more descriptive result it was preferred to remap the surfaces using high resolution images taken with professional Digital SLR cameras. Importing complete parts of the pointcloud in Raindrop Geomagic, it was possible to create very good quality surfaces and apply on them the images using the classical workflow offered by this software based on the definition of corresponding points between the image and the surface. The need to produce a lightweight 3D digital model for multimedia and dissemination purposes was faced using common procedures based on the extraction of a normal map from the high resolution model, applying the procedures of decimation and optimization on the same model and then using the normal map over the simplified model to create a virtual enhancement of the level of detail according to the original, not simplified surface.

The small size of the Meryemana church required quite simple processing, but the partially surveyed rooms at the lower levels needed some special treatments to came out at a good quality level. Some reference curves and some interpolated element were traced between the partially created surface, and later an accurate work of modelling was done to complete and to make this minor rooms realistic and well compliant with all the rest the 3D digital model. When all the surface models were completed and all the normal map extracted, the surfaces were simplified. A first 55% reduction model was created for general purposes and drawing extraction, while a 10% reduced model was prepared to be better suitable for multimedia use. Both

the models received back the original normal map coming from the full resolution model, creating a good and well working set of models for multimedia and/or analysis uses, the models are capable to offer surface/curves extraction or to be the base for image production, all common tasks for this kind of workflow and fully operational to create the basis for further studies.
The digital survey is the right base to start projecting possible interventions on the church and its mural paintings. While visiting and surveying this church it was clear how all the traces of previous diagnostic tests (glass elements placed bridging the crack) were showing a progressive deterioration of this alteration, in facts none of the monitoring glass was in place any more, only the mortar used to position them was remained. A visual check was done looking at the Pasolini Medea's movie, it allowed to verify the crack growing, in the frames from the movie it appears smaller and not so accentuated, but it possible to observe it only in few frames. The main problem is the missing of quantitative documentation of this damage. So, in the second survey campaign, in September 2013, a great attention was dedicated to the outer parts of the peak, trying to put in evidence the consistence of the crack. But the gate closing the passage remained closed: the officer responsible of the museum area gave no authorization to access the church, considering it too much dangerous. A hard choice, but an evident signal about the desperate conditions of the church. The new survey was taken all along the peaks and all along the ridges as well as inside the passages and the caves around the church. This was done to have the maximum level of details from the stone system all around the church and its crack. The whole reconstruction phase did not give any meaningful difficulties, the high quality of the scans made all the details very readable and the alignment was completed in few days. When the new set of aligned pointclouds were ready, they have been composed and mounted with the previous survey. This second operation was rapid and gave no surprises, all the parts went into the "right place" with a very low error levels (a certain variation in the surveyed are was expected because of the changes in vegetation). The classic procedure of alignment, based on target recognition and geometrical confrontation between pointclouds proved to be a very well working solution even in this case. The final result was quite impressive, but not a complete survey yet. In fact the almost flat front of the peak, facing the valley, was an impossible surface to reach from the side where the church is, while the dense vegetation and the meaningful distance of the other side create the conditions to make impossible covering the whole stone surface. Only a further survey, operated from the opposite side of the valley, using a time of flight, long range laser scanner, will be able to make the coverage complete (this third survey is programmed for the September 2014).
The actual dataset allows to read clearly the relationship between the carved rooms, the mass of the peak, the valley and the crack. The whole crack is clearly readable in the inside, and now, for the first time it is possible to read it with no doubts on the external surface of the peak. Even if it is impossible to scan all along the inside surface of the crack, the correspondence between the outer and inner signs allow to quantify and read the incoming collapse of the whole system. The mass of the moving part of the peak is easily defined, and show the repetition of the process that caused the "flat" face of the peak toward the valley. The volume is enormous, it comprehends a top part 17 meters high over the church and cross the whole peak, opening from the church to the sky. It is worth to say that this process is fully natural, it's in the part of the evolution of this stone, the carved rooms has probably speed up the erosion process of some parts, helping the felt of the connections corridor, but the church in itself is simply across the typical decay of this peak. It can be confirmed observing the "flat" front of the peak toward the valley, where it is possible to see an older fall,

leaving the surface exposed with no trace of rupestrian spaces, but the further phase of decay is now crossing the church and creating this impressive condition.

## Conclusions

The condition of the Meryemana church seems beyond the possibility of a recover, the gradual decay of the stone is something hard to be controlled or managed and the conditions of the peak in this case seem quite impossible to the faced. Overall the digital documentation came out to be a great choice to “freeze” the state of the monument, maybe the fall of the peak will take a long time, but sooner or later it will happen with disastrous consequences. An intervention of consolidation seems greatly out of scale in front of the size of the church in itself and the fragile condition of the whole asset should receive an even more disastrous effect from a wrong intervention then from the natural process of the events. The digital preservation of the church can be an interesting alternative, using multimedia and online solutions, but an even more interesting solution can be evaluating the possibility to create a physical clone of the church. This can be done starting from the highly accurate digital model and with a well detailed solution, creating a resin or even a stone made clone of the original. The mural paintings can be reproduced in more than one solution using complex digital processing or more traditional techniques, or it is even possible to imagine a “multimedia space”, using the physical clone as the space to receive multimedia or even interactive projections of the paintings. This last solution can be considered very experimental and can bring to the limit the sense of “copy”, creating a clone loosing something because its nature of copy, but acquiring a lot in its nature of extremely new and digitally oriented solution. At the same time the clone can be accessed from any other part of the museum or can be even mounted and unmounted for different events and needs. The experimentation in this direction is on the run, and it is possible to foreseen well working proposals in the next months. This kind of approach may bring two main benefits: first of all it can capture the attention over a meaningful Cultural Heritage element at risk, allowing its “virtual” visit and understanding its real importance, on the other hand, this digital approach can help in finding the needed resources and the appropriate reflections before operating any intervention over the monument, avoiding inaccurate choices to be taken, and allowing, first of all, a better comprehension of the strategies for preserving, protecting and presenting the rupestrian heritage.

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Fig. 1 – View of the inside of the church

Fig. 2 – The great crack passing all over the vaults

Fig. 3 – Horizontal section toward the vaults of the Meryemana Church (reference scale in meters)

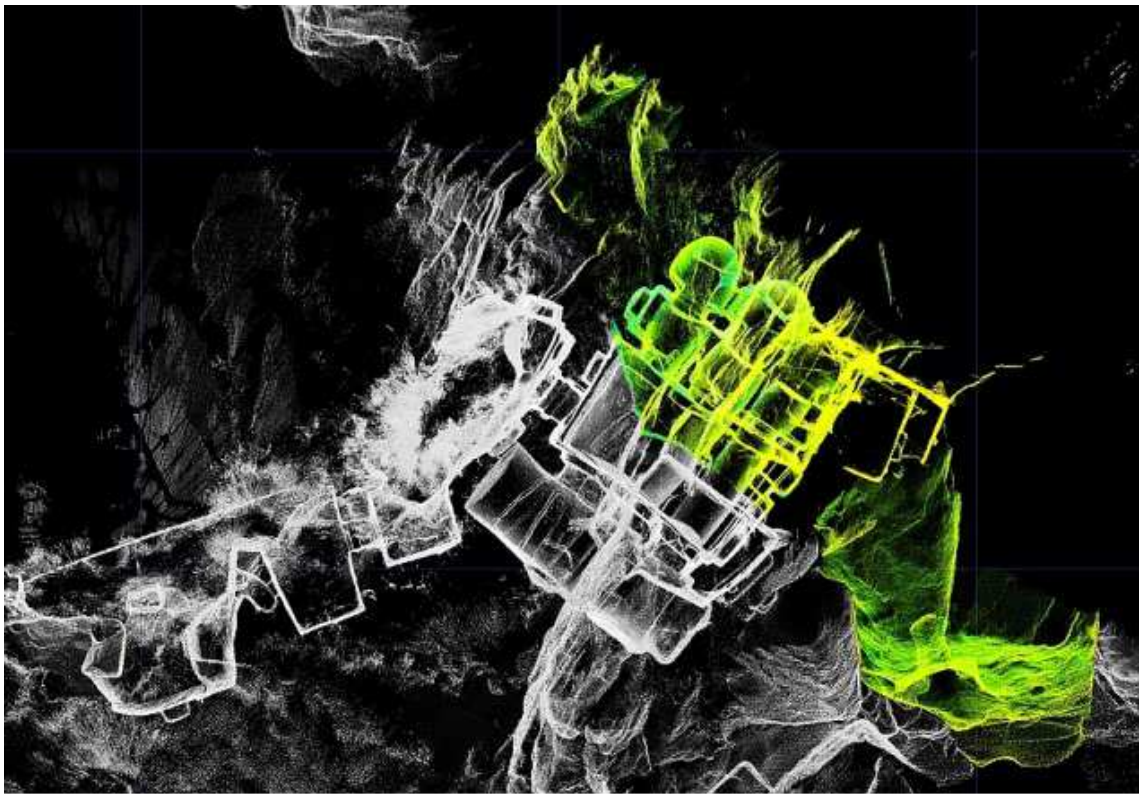

Fig. 4 – The part of the peak moving down affected by the crack: underlined, the global pointcloud model using green and yellow tones there is the falling volume (top view, grid size equal to 10 meters).

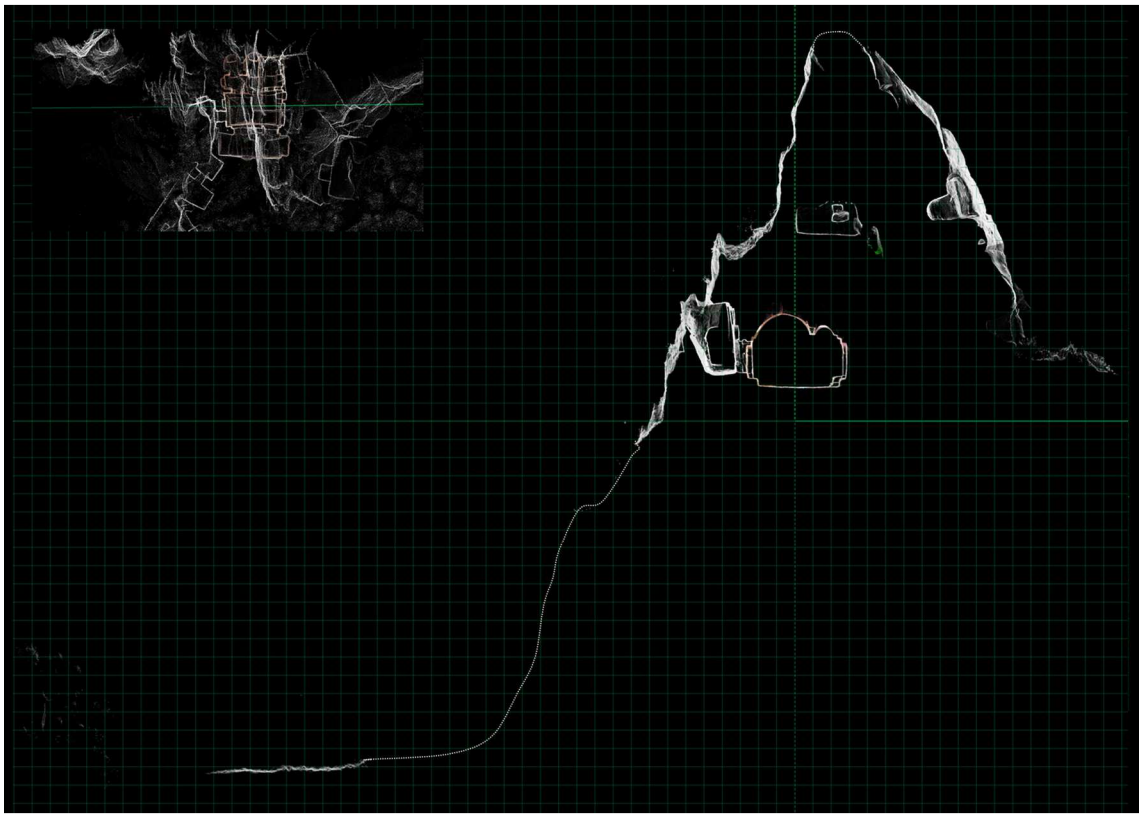

Fig. 5 – Vertical section across the church and across the valley (grid size equal to 1 meter).

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