Göbekli Tepe, Turkey

Preliminary Site Conservation Inspection and First Mortar and Plaster Documentation Report

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GHF Staff:
John Hurd, Technical Conservation Consultant
jhurd@globalheritagefund.org

Dan Thompson, Director, Global Projects & GHN
dthompson@globalheritagefund.org

Project Director:
Prof. Dr. Klaus Schmidt
Deutsches Archaeologisches Institut
kls@orient.dainst.de

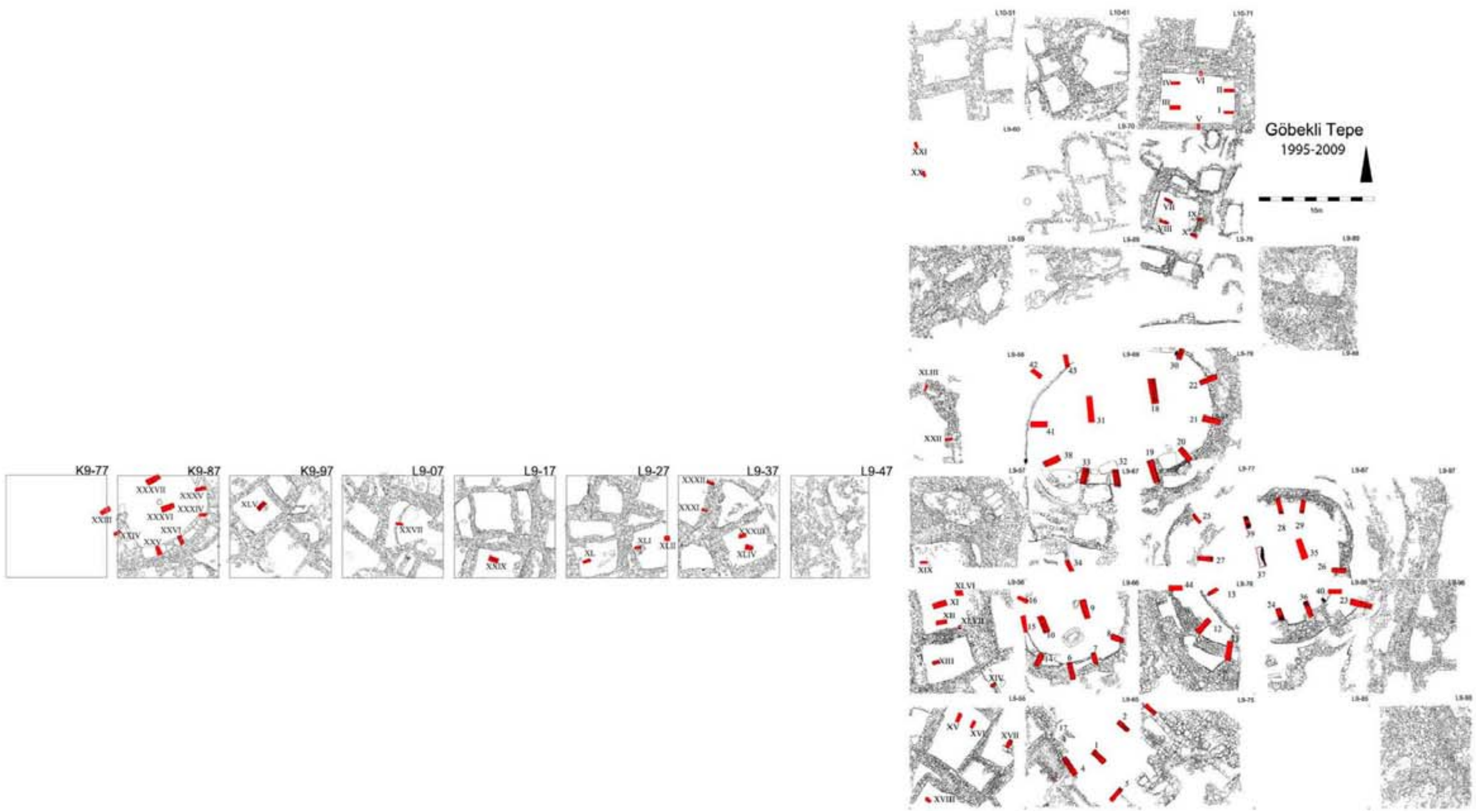
Site Background

The circa 150-meter-long and 300-meter-wide Early Neolithic site of Göbekli Tepe (Belly Hill) is situated about 15 kilometers northeast of the modern city of Şanlıurfa in southeastern Turkey at the highest point of an elongated mountain range. Since 1995, archaeological work by the German Archaeological Institute (DAI) has been carried out under the direction of Prof. Dr. Klaus Schmidt. Göbekli Tepe is not a settlement but a sanctuary, probably a regional centre where communities met to engage in complex rites. This interpretation is supported by the fact that the annual excavation seasons since project inception have provided no evidence of residential buildings or fortifications but exclusively monumental, megalithic stone circles dating to the Pre-Pottery Neolithic period (10^{th} – 9^{th} millennium B.C.). That the sophistication in construction evidenced at the site existed in this period, one of the most important in the history of humankind at the dawn of sedentary and farming communities, makes Göbekli Tepe arguably one of the most important sites under investigation today.

Monolithic T-shaped pillars, each often weighing several tons, were erected here forming large enclosures in whose centre another pillar or pair of pillars tower above all (see map of the enclosures and the pillars in situ). The arms and hands depicted on their sides allow us to understand them as anthropomorphic. Furthermore, there are large-sized reliefs added to these pillars showing wild animals like large cats, bulls, wild boars, foxes, birds, scorpions, spiders and snakes. These reliefs open the view upon a new and unique picture language not known before, and the interpretation of these remains an important factor of research discussion.

Professor Schmidt estimates that the life of the site may have been approximately 1500 years and that during this time the tendency to build enclosures containing T-shaped and relief-carved stones, and further ringed with T-shaped stones, started with the construction of large examples and that these reduced in size over time. It is clear to John Hurd that there is a significant difference in sophistication of construction technology of the mortars over this time.

As Professor Schmidt points out, the earliest part of the Göbekli Tepe site may represent the peak of Stone Age technology which then declines towards the end of the site's life as the introduction of agricultural activity develops. This would mean that Göbekli Tepe is not the start of a stage of human development but in fact the end, implying that these advanced stone technologies started at a much earlier time.



Above: Plan of principle excavations, 1995-2009.

Technical Background

Note that this report is concerned first and foremost with initial considerations of site conservation, one of the four tenets of *Preservation by Design®*. Details on planning, community development and partnerships – the other pillars of *Preservation by Design* – are addressed elsewhere, most notably in the project prospectus documentation or in reports devoted specifically to those topics.

Mortars.

Mortars are used in various forms and applications across the site.

While the large T-shaped stones seem to stand free and are occasionally socketed into shallow sockets in the bedrock, occasionally consolidated by flint and chert wedges or chinking stones, between the monoliths are mortared, rough stone walls which support the monoliths in several techniques and also divide spaces within the patterns of the position of monoliths in each enclosure.

The rough stones are to some extent shaped on the face, and occasionally there are protruding stones, whose function is not yet fully understood.

These walls vary enormously and are constructed at varying levels, may be straight or concave, can support horizontal stones as tables or other flat features, and the stones used may vary in size and so on, leading to the conclusion that the walls represent a range of construction dates through the life of the site. This opinion is further reinforced by the nature and content of the mortars that support the wall.

The mortars across the site vary in colour, granulometry and composition and this may be interpreted in several ways. In some positions the walls act as buttressing walls against the hillside slope, and in these the “strength” of the mortar, especially the clay proportion, may reflect this.

In another scenario the change in mortars my represent improvement or decline of technology over time, and if this is the case then the mortars may assist in providing chronological information for the construction of the walls and the chronology of changes in the form of the enclosures.

Over the history of the site’s use there is compelling evidence that the enclosures were intentionally backfilled and this backfill material is by no means random or primitive, having evidence of clear lamina and also the use of intentionally placed mortars.

Mortars throughout the site propose an extraordinary level of sophistication in the understanding of their use. The attachment of mortar to stone is generally significantly well achieved.

Generally when mortar is used in any masonry structure, the observer would expect to see micro cracks and cleavage features related to shrinkage and mechanical or vibrational activity over time. At Göbekli Tepe the attachment between mortar and stone remains intimately close and strong. This implies that construction was sophisticated enough to support the theory that the stones were well wetted down during construction. The author regards this attachment remarkable, given that these joints are 12,000 years old and that an enormous effort needs to be made to transport water to mix the mortar and to reduce suction by wetting the stones during the building process.

It is clear that careful characterisation and analysis will be required in order to further understand the data and archaeological information that the mortars offer.

Throughout the mortar series there is variable weathering to the level of the mortars between the stones, from wall to wall. This is almost certainly a result of the different seasons of excavation, with deeper erosion in those walls that were uncovered earlier, or it may reflect differences in the mortar mixtures; this needs careful study.

There is frequent evidence of insect activity within the mortars, especially masonry bee holes, since excavation.

Above: Wall bay between monoliths.

Above: Detail of wall with good pointing, recently excavated.

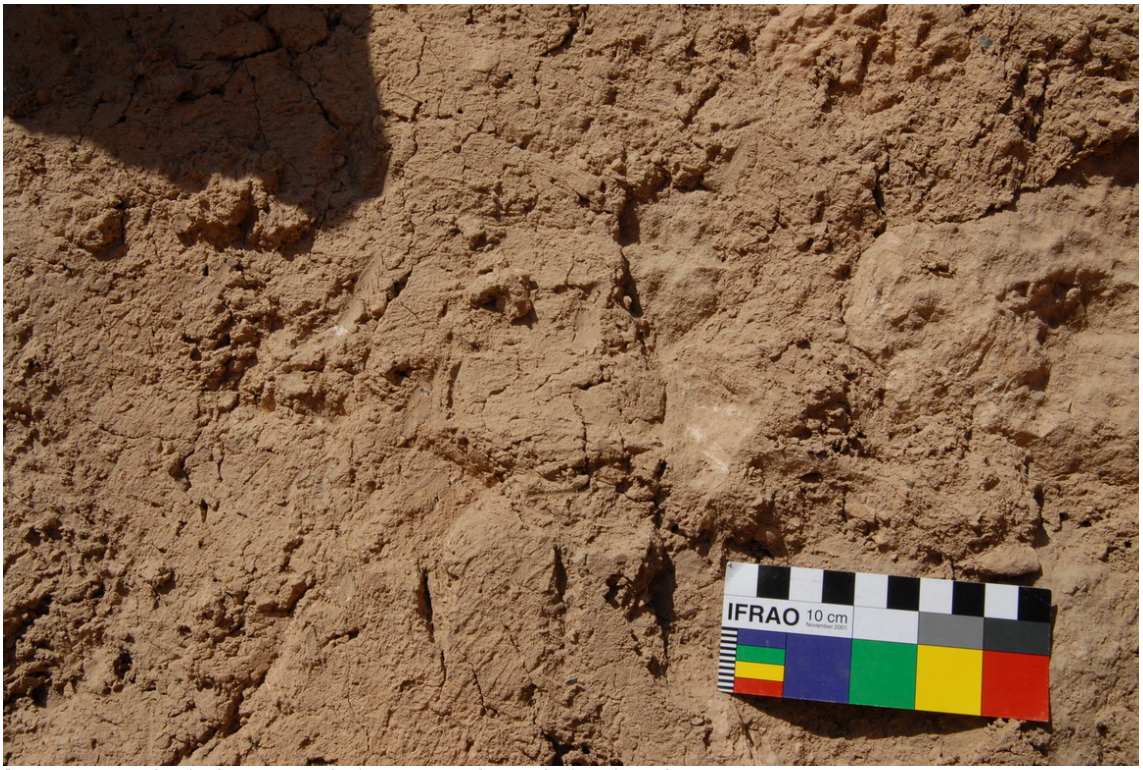
Above: Detail of wall with eroded pointing, excavated in 2005.

Above: Detail of intentional infill, section.

Plasters.

In various positions of the walls there is occasional evidence of the mortars extending to use of plasters. Those examined by the author were unsophisticated plasters roughly applied by hand and "daubed" unevenly over the wall. There are small marks in the daubed surface that the author interprets as vestigial remains of small soft finger marks.

Above: Daubed plaster lower wall with damage to wall above.



Above: Detail of plaster with finger marks to left of scale.

Artificial Stone.

There are several very significant materials associated with the site, and these include artificial stone (terrazzo) floors in some of the later enclosures and the presence of examples of a "concrete" manufacture within re-used basins left by the extraction of large stones from nearby quarries.

While there is no evidence of lime burning technology, there exists the strong possibility of soft marly limestone minerals (Marl is normally in the index 5-15% clays and 85-95% carbonates), in the climatic conditions, contemporary to construction, of marshy ground in the forested plains below. These soft marls when mixed with sands and aggregates would produce a type of concrete on drying, and this may have been the source of the terrazzo floors. Clearly more research is needed into this possibility of the use of concretes at such an early date.

Above: "Terrazzo" floor in need of consolidation.

Above: Monolith excavation pit in quarry, reused and containing traces of "concrete".

Stone.

Göbekli Tepe lies in a limestone region, and around the limestone monuments in the circles of the archaeological site is a landscape profoundly changed by the working of limestone, stripping the surface off the natural limestone pavements, with wasted limestone rocks lying on the surface. Klaus Schmidt points out that this is not a natural landscape but a cultural landscape converted through human activity.

Within the landscape are numerous piles of knapped flint which demonstrate a continual flint knapping industry. Flint tools and other stone axes were used to extract the huge T-shaped monoliths, and although not immediately available on the hill at the site, it is not in short supply.

There is no evidence of burning as part of the quarrying activity, but the supply of water artificially brought to the quarries and to the Göbekli hill is strongly in evidence.

The monoliths themselves show a very fine ashlar surface, decorated with representative and in some cases contiguous bas relief. This is not primitive work and implies an historic and well experienced stone technology.

The site team includes a stone conservator/mason, Andreas Gotz, a.goetz@stein-denkmal.de who is an active and capable conservator. Together with Eduard Knoll, knoll-rothenburg@t-online.de architect and civil engineer, they represent the core stone team.

Above: Monoliths in Enclosure B showing reuse/repair.

Above: Detail of fragile ancient repair, also in Enclosure B.

Above: Bas relief decoration depicting a fox.

Above: A contemporary patch in stone floor with basalt wedging stones.

Above: A contemporary patch in stone floor with basalt wedging stones.

State of conservation

Until now little formal conservation has been achieved, but the archaeological team has taken steps to preserve the mortared and plaster-daubed walls by introducing an outer dry stone protective lamina which is providing very efficient temporary protection to the ancient walls.

Clearly this cannot remain in place as the outer lamina is somewhat unsightly and alters the dimensions of the main structures.

Above the upper smaller enclosures is a simple and functional metal shelter structure, which is serviceable.

Some limited stone conservation has been achieved with unset monoliths supported by raking shores and anchored cables. One large broken stone has been rejoined using an epoxy resin adhesive. This repair urgently requires further attention in order to prevent free moisture from entering at the edges of the repair during winter 2011, and John Hurd recommends that a temporary hydrophilic plaster be applied across the crack to control water ingress that may contribute to hydrolysis and swelling of the adhesive over time.

While archaeological research has gone ahead for many years, the conservation of what has been excavated has not kept pace, and there is now a considerable backlog of work needed both in repair and reassembly of broken stones and in the conservation of mortars, plasters and extraordinary “terrazzo” floor coverings.

Andreas Gotz and Eduard Knoll have a continual programme of stone repair, and it is important that they start training local people in the techniques used for stone repair or the conservation will continually fall behind the archaeological research.

John Hurd is happy to lead the conservation of the earth mortars and plasters, should the project director require this, and this also will need to produce local conservators to continue the work during the whole season.

During the spring season of 2012, both the stone conservators and the earth conservators should conduct intensive training courses to ensure that work can continue for the whole season.

Conservation requirements

An urgent conservation requirement is the need to gather pertinent data in order to start the process of understanding risks to the site and its archaeological features.

The first requirement is the establishment of weather stations in at least two contexts: on the open hill and in the deepest excavation trenches.

These need to monitor all normal climatic measurements, and Hurd proposes that these store data in electronic memories which can be transferred from time to time by USB connections into team computers. A member of the archaeological team will need to be identified to co-ordinate this activity, and the data must then be used to interpret and define the risks to the site.

The other principal conservation requirements centre around the stone, mortars, plaster and terrazzos in equal importance, with monoliths occasionally damaged, and historic evidence of support of broken elements employing earth-mortared support walls as collared buttresses and so on.

The conservation challenge mainly addressed by the author is the consolidation and protection of the earth mortars, plasters and artificial stone floors.

The mortars and plasters are very vulnerable to weathering and erosion through the action of wind and rain and especially in the rare event of a violent rainstorm, which would, in a short period, do widespread damage. Climate change must be engaged as a serious risk at Göbekli Tepe.

Shelter structure

As a first principle, there is no question that the most important conservation tool for this important site which remains at high risk from environmental erosion is the construction and use of shelter structures, and to that end a very functional shelter structure had been designed to shelter the main excavated monumental enclosures.

However, this design has now been superseded by an alternative design supplied by the German Archaeological Institute, and Hurd has concerns with this structure.

The Archaeological team have limited options for placing the support posts for any structure. The new design seems to ignore the ideal positions proposed by Klaus Schmidt and places the posts in other positions, suggesting that the new design was achieved for form and beauty rather than function.

A shelter structure is a conservation tool, and function should always precede form. No useful design could be made without the designer having intimate knowledge of the function.

The new design foresees a tensile textile as the main protective roof, and this is very acceptable within the constraints of the design life of the structure and the need for diligent maintenance.

The environmental and climatic conditions at Göbekli Tepe include lively and dusty winds that will deposit large quantities of dust on the shelter roof. Design of the roof must therefore reflect this condition and as such should avoid valleys and other features within which the dust may settle. When dust settles on the roof and other elements of the structure, then during rainfall the dust will be deposited on the archaeology surrounding the roof, and drainage systems may become blocked with potentially disastrous impact on the moisture content of the archaeology. Dust, forming on the proposed white tensile roof, will quickly make the roof unsightly and inefficient. John Hurd urges the German Archaeological Institute to revisit the design with these challenges in mind.

Hurd stresses that the chemical integrity of the Göbekli Tepe site must be a priority, and this includes the protection of the site from pollutants such as the introduction of concretes made with ordinary Portland cements and other chemical admixtures.

The foundations for posts of any shelter structures should be isolated from the archaeology by placing an effective separation layer between the concrete foundations and the archaeology. This separation layer must perform as a "cordon sanitaire" between introduced materials and the original materials on the site.

The research techniques of archaeology are changing in terms of many micro research techniques which can gather important chemical data from the site and this must be protected in so far as possible.

Conservation Materials Research and Testing

Minimal Field Laboratory.

As conservation progresses, supported through Global Heritage Fund, there will be a need to establish a small field laboratory on site.

While initial research towards characterising the mortars and plasters will be achieved by outside laboratories, conservation on site will greatly benefit from basic characterisation equipment, a dry sieving tower, sedimentation vessels and a small binocular photo microscope.

Tools, trowels, pointing irons, water spraying equipment and so forth will also be required as intervention starts. Hurd will assemble a complete list of conservation equipment required for the 2012 Spring season.

Permissions and Consents.

Since permissions and consents will be required for the sampling of materials to be examined, characterised and tested, Hurd proposes that this be done, as far as possible, by Turkish institutes.

There are two main institutes that may be acceptable partners in this activity. The Middle Eastern technical University (METU) in Ankara and the local Harran University Department of Agriculture in Şanlıurfa.

Mortars and Plasters.

Mortars, plasters and artificial stone floors will need to be characterised, especially through the production of granulometry data to allow for comparison of both chronological and reuse purposes. This is a relatively simple process and can be carried out in any well equipped soil science laboratory.

Microscopy.

Samples can be examined on site through the use of a small standard binocular photo microscope; this can have many uses for both the recognition of anomalous contents of building materials for conservation purposes and for archaeological research examination of the same materials.

Mass Spectrometry.

In some cases, materials samples may require a deeper understanding, especially when specific clays or general admixtures to materials require further characterisation. This can be achieved through mass spectrometry which is available at Harran University in Şanlıurfa or through other spectrometry techniques available at METU.

Test Walls.

Once conservation materials have been identified for use on the monument, these should be tested for at least one full year to examine their performance. Tests cannot be ethically carried out on the authentic and ancient material and so Hurd proposes that a series of small test walls be constructed on site for the purpose of experimentation.

Proposed interventions

Temporary Protection.

Before the end on the 2011 season, temporary protection must be made of certain vulnerable aspects of the site. These objects are vulnerable to climate erosion, mechanical damage and theft.

Ed Knoll is listing and prioritising these temporary protection incidences and methods now and in co-operation with the archaeological team and Hurd and the conservation team.

Active Conservation Intervention:

Stone.

In respect of the stone conservation and following discussion with Andreas Gotz and Eduard Knoll, Hurd has proposed that in depth discussion and research is made into the selection of appropriate adhesives for the limestone repairs to be made at Göbekli Tepe. Hurd will introduce Andreas Gotz to the ICOMOS International Scientific Committee on the Conservation of Stone, and Gotz may use this committee as a forum to compare advice from stone conservators around the world, prior to deeper discussion with adhesive manufacturers, in respect of stone type, climatic conditions and so on.

Mortars and Plasters.

In respect of the conservation of mortars, after the materials have been characterised, a series of tests will be conducted.

It is very likely that new material, similar or identical in composition to that found in the historic context, will be added in a “repointing” process.

As this process continues, it will be necessary to be able to clearly identify the difference between authentic original material and conservation materials.

Since clear separation layers cannot be introduced for many reasons, especially the need to avoid creating cleavage planes, the conservation material should have an indicator medium introduced into the mix.

In this case Hurd recommends the addition of glass microspheres to the conservation material to perform as an indicator and to add to the compressive strength of the material.

Since the conservation repointing will require periodic maintenance, Hurd also recommends that carbon or synthetic polymer rods be inserted horizontally into the repointing mixes. As the conservation repointing is eroded in natural conditions, these maintenance indicators will be revealed and will indicate that further maintenance repointing is required.

Details of these ideas will evolve in detail as the conservation planning becomes more detailed.

Artificial Stone Floors.
The artificial stone, “terrazzo” floors are vulnerable to climatic erosion, mechanical erosion through wind, animals, flora and so on.

These terrazzos may require consolidation through repair to lacunae.

Detailed planning in this respect will follow as a greater understanding of these floors emerge, through analysis.

Monitoring

Clearly all results of conservation intervention will need to be included in a programme of inspection and monitoring. As mentioned above, in some cases monitoring indicators can be used, but in general the appropriate monitoring programme should be conducted by an experienced conservator.

Pre- and Post Shelter Structure Conditions.
Over the next years, environmental conditions will be subject to considerable change, especially through the introduction of a shelter structure or structures.

The conservation programme will need to be designed with this in mind and testing will need to reflect the change.

Training

Hurd sees the need for training to be given starting in the spring season of 2012 and this training will operate on two levels:

1. Internship and academic placements Schmidt may choose to encourage conservation interns from Turkey and other places.

2. Local workers will require training to perform general conservation activities during the intervention phases, and these would be selected for comprehension and study.

The training of local archaeological workers to a higher level towards conservation skills can be an important part of the GHF *Preservation by Design* model for community development.

Team and Partners

GHF is partnering with the German Archaeological Institute (DAI) and the Turkish Ministry of Culture and Tourism to preserve Göbekli Tepe.

The final composition of the conservation team is to be discussed further.

Material Stocks

There are several considerations in this area, and perhaps the main need is to locate and collect appropriate earth materials in the surrounding landscape to act as the basic content of the conservation intervention material for the mortars, plasters and artificial stone floors. The Harran University earth science faculty may be able to help in this respect.

Other admixtures, glass microspheres, possibly hydrated lime and so on will need to be sourced from local suppliers, if possible, and found safe storage at the dig house in Şanlıurfa.