ZRS
Ingenieure

Project report

EMERGENCY CONSERVATION OF THE WHITE TEMPLE

URUK, SOUTH IRAQ

Titel: 3 phases of emergency conservation | interlocking sheathing of the original finding according to detected remains at the masonry base (front) | exposure of the solid core (centre) | ground consolidation (back). Adapting to the remains of original masonry made of earth blocks
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Completion of the supplementary works in autumn 2022, view from NE
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FACTS

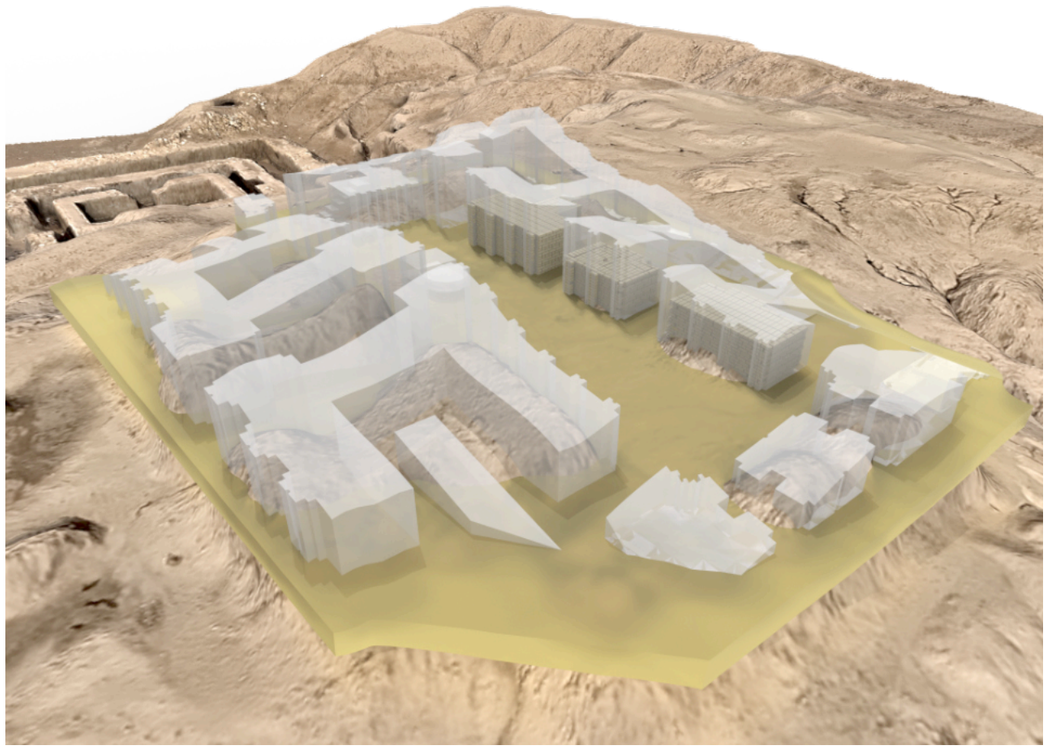
COMMISSIONING PARTY
Federal Republic of Germany, Federal Foreign Office

PROJECT MANAGEMENT
German Archaeological Institute, Berlin, Dr. Margarete van Ess

EXECUTION
ZRS Ingenieure GmbH, Berlin
together with Lovis Lehmbau, Dreiskau-Muckern

CONSERVATION CONCEPT PLANNING &
SPECIALIST PLANNING FOR EARTHEN CONSTRUCTION
ZRS Ingenieure GmbH, Berlin:
Christof Ziegert, Jasmine Alia Blaschek, Riccardo Fanton

PROJECT DURATION
since 2016 ongoing



Conceptual phase – hypothetical assumption of the extent of the emergency securing works compared to the excavation state of the 1930s
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PROJECT DESCRIPTION

The ancient metropolis of Uruk lies 300 km south of Baghdad, on the western edge of the Sumerian heartland in the alluvial plains between the Euphrates and Tigris rivers, in what is now southern Iraq. Important achievements of civilization such as writing or the development of complex administrative and social structures originated in Uruk, founded at the end of the 5th millennium BC.

The German Oriental Society and later the German Archaeological Institute (DAI) have been excavating monumental sanctuaries, monumental buildings and residential and representative buildings on the site of Uruk since 1912. A large part of these building remains consists of earth building materials, mainly earth blocks. With the award of UNESCO World Heritage status in 2016, the obligation arose to develop a coordinated conservation strategy for the archaeological site of Uruk. This task is being led by the DAI through Margarete van Ess, planned by the Berlin offices of Klessing Hoffschildt Architekten (KH) and ZRS Ingenieure GmbH (ZRSI), and implemented with Lovis Lehmbau (LL), together with local colleagues from the State Board of Antiquities and Heritage Iraq (SBAH) and local workers.

The first major emergency conservation measure by ZRSI and Lovis Lehmbau to secure the overhangs was already carried out in 2018 at the western corner of an approximately 4200-year-old man-made temple mound (made of approximately 11.5 million earth blocks!), the so-called Eanna Ziqqurrat. Since 2019, ZRSI's conservation concepts for the White Temple on Uruk's oldest ziqqurat, the so-called Anu Ziqqurat, have been developed and – after years of work interruption – started to be implemented in autumn 2022. In contrast to the Eanna Ziqqurat, the Anu Ziqqurat does not have any re-inforcement layers made of reed mats, which is why the surface erosion is much more advanced. However, this earth block massif is characterised by millennia-old horizontal waterproofing techniques using bitumen mortar. One of the most valuable findings in Mesopotamia can still be found in remains on this Anu Ziqqurat, the so-called "White Temple", built around 3500 BC, which is the world's first and only preserved temple on a ziqqurat and which is the subject of the current emergency securing measures of ZRSI in Uruk.

According to the excavation plans of the DAI, the so-called "White Temple" is a central hall building measuring approx. 22 m x 17.5 m and oriented northeast-southeast. The state of excavation of the White Temple in the mid-1930s showed extensive remains of white lime paint on the walls in the exterior and interior, as well as on the floor, which is why this building was then called the "White Temple" by the excavators. The excavation work under the direction of Ernst Heinrich also led to the underlying layers "D/E", where remains of a building or temple with a similar ground plan, but slightly offset, were found, the so-called "Building D/E" or "Temple D/E". The excavation works down to Building D/E resulted in the floor in the interior of the White Temple as well as its base terrace and the fill between Building D/E and the White Temple being almost entirely undermined by exploratory tunnels or opened up by search trenches. Since the documentation of these excavation

Anu-Zikurrat in Uruk, with remains of the White Temple:
start of emergency conservation of the NE central hall wall in autumn 2022
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NE central hall wall after soil consolidation in autumn 2021: removal of the eroded layers (left) compared to the pillar remains of the centre of the picture as well as at the back
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Phases of implementation: soil consolidation (left) | cleaning of the eroded layers (centre) | emergency-securing addition to the masonry with earth blocks and earthen masonry mortar according to the characteristics of the original (back).
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Completion of the soil consolidation (left) | emergency securing supplementation of the original finding (centre) | completion of the supplementation work (back).
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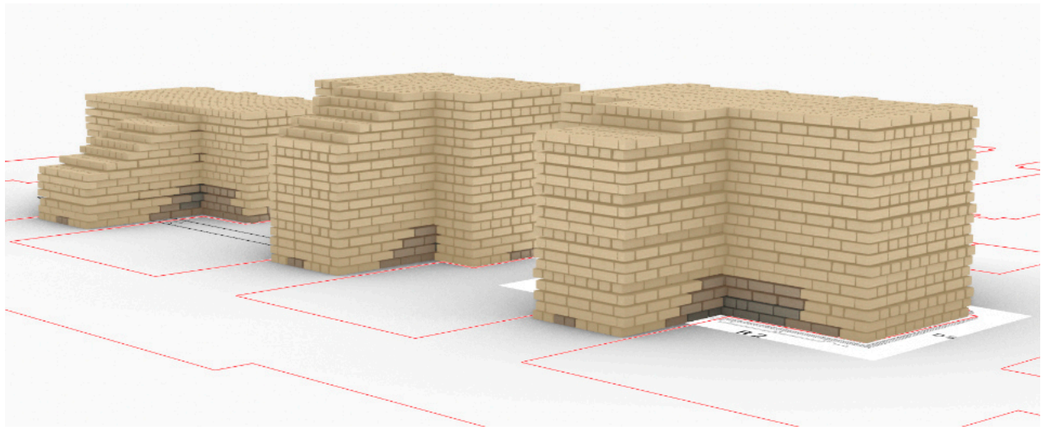
works has not been completely preserved, it was therefore unclear whether and in what way these areas had been refilled and what stability of the subsoil was to be expected here. Investigations in autumn 2022 revealed some conspicuously loose material here.

Since its excavation in the 1930s, the White Temple has thus been exposed to the weather unprotected for almost 90 years to date. The remains of the north-eastern central hall wall were identified as the most endangered remains of the White Temple, as they have the highest cultural value due to the legibility of the temple floor plan. As the few architectural remains of the White Temple are already heavily eroded, sampling was only possible to a limited extent. Therefore, a zero sample as well as further comparison samples had to be omitted. Various analytical methods were used to analyse the finds from the White Temple. The salt contents were determined both ion chromatographically by the FH Potsdam and photometrically in advance for initial assessments in the ZRSI laboratory. On selected samples of the inner core of the original masonry, ZRSI carried out shrinkage, modulus of elasticity, compressive strength, analysis of binder and natural lime content, and sieve analysis in order to be able to develop suitable conservation earth building materials with on-site materials and manufacture them in Uruk together with regional workers. In addition, the results of the X-ray diffraction (XRD) clay mineral analysis of the ARCHEA Laboratory for Archaeometric Analysis and Research in Warsaw (Poland) showed that the modern earth block sample from the selected, regional conservation materials – specifically from the Great Euphrates Canal – corresponds in its clay mineral composition to the original earth block sample or is even identical to it, thus confirming that this earth block material was already used for the construction of the White Temple 5500 years ago. Likewise, testing the compressive strength on the original material sample with an outstanding result of 4 N/mm2 confirmed the hypothesis of the archaeological team, who had originally described the temple as two-storeyed.

In regular meetings, which took place both in Berlin and during the stays in Iraq, the feasibility and utility of the various options such as enclosure, roofing, sheathing of the findings up to the refilling of the area were discussed with the DAI and KH as well as with the Iraqi team of the SBAH. The option of encasing the findings of the north-eastern central hall wall in earth block masonry, interlocking with the remains of the original masonry, was finally supported by all parties. This option of sheathing the findings initially means freeing the remains of the wall pillars from the crust and loose, already eroded material down to the solid core. At first glance, this seems a drastic measure, but it is important because transport mechanisms (especially salts) are not or hardly effective in porous and loose material, and the original core would then remain exposed to its decay processes inside the casing. In this respect, it is essential to remove eroded layers, encase them in an interlocking manner with earthen masonry mortar and earth blocks, and plaster them with an earthen plaster of appropriate thickness that can be regularly maintained.



Conceptual phase - preliminary planning of the supplementary works according to the sketch of the masonry bond by excavator Heinrich (DAI)
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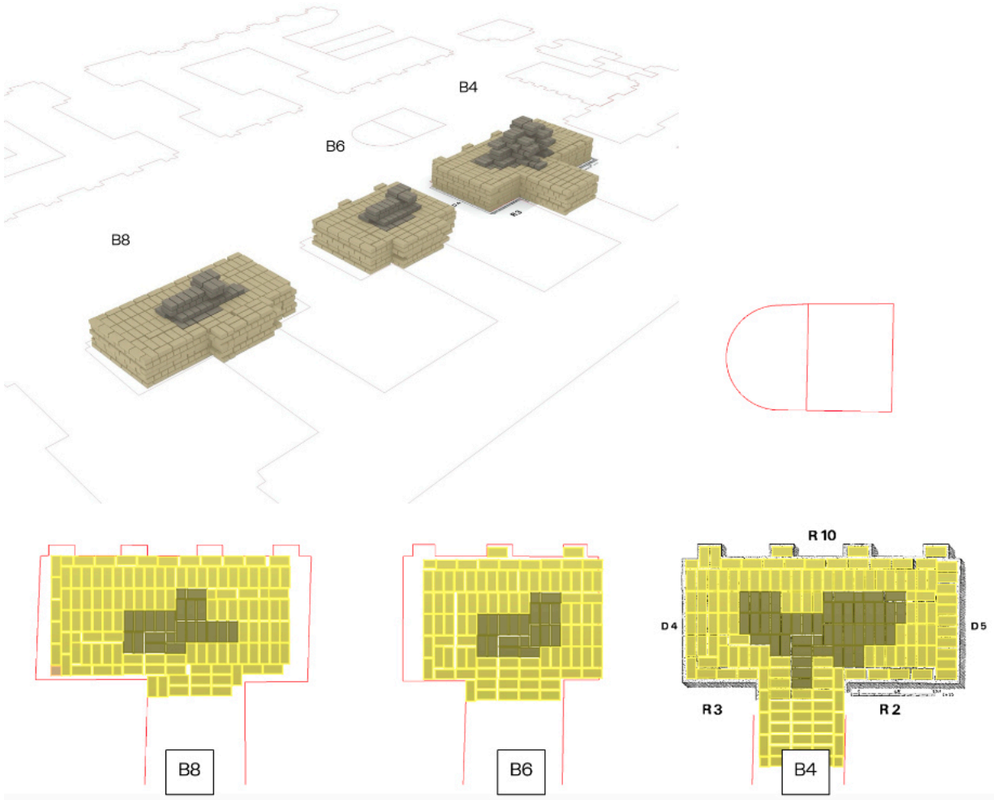

Conceptual phase – principle sketch of the addition to the original findings
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The earthen plaster layer ultimately serves as a sacrificial layer and consequently the sheathing not only results in a mechanical protection against weather influences such as wind, rain and sandstorms, but at the same time in a desalination process of the original material. Consequently, the original findings are preserved in the long term.

Work on consolidating the soil in the vicinity of the findings was carried out in autumn 2021. The supplementary masonry work itself was carried out on two of the three findings in autumn 2022. The original masonry bond could be recognised on the basis of Heinrich's sketches as well as by exposing the structures, and could be executed accordingly. Details such as pilasters, which were still preserved in rudimentary form under the erosion cone of the two findings, completed the ground plan of the pillar remains and thus provided the contour of the sheathing. Consequently, the pillar remains could be preserved, even if their condition was not perfectly solid. Original findings of the white paint, which came to light sporadically during the uncovering of the erosion layers on the two of three findings so far, were secured by the experienced restorer Daniela Geyer from WERKart Restoration and also integrated into the earthen plaster, so that they continue to be preserved in their original substance. In the autumn campaign of 2023, horizontal surfaces were then finally protected against excessive moisture penetration into the masonry with a so-called capping of earthen masonry mortar and ceramic shards. Our concept has already withstood several heavy rains in the winter season of 2023, although regular maintenance by our Iraqi colleagues will determine its long-term success.

Earth block production on site under supervision of SBAH
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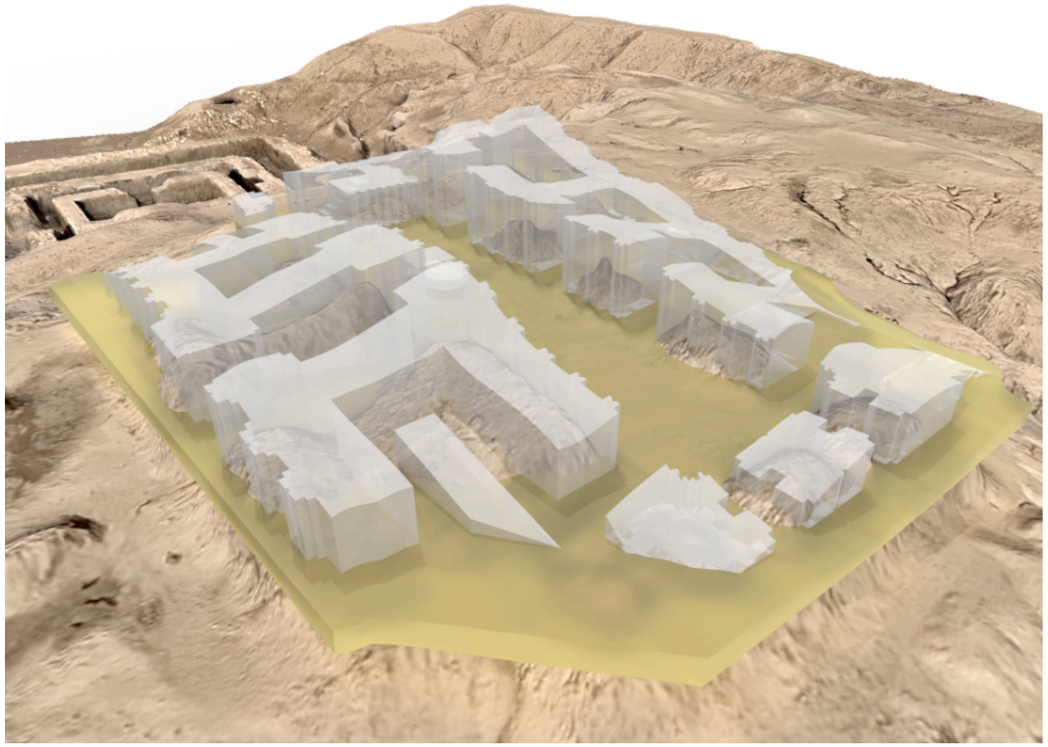

Conceptual phase – condition of the White Temple in 2017 (DAI) with reconstruction of the excavation condition of the 1930s (ZRSI)
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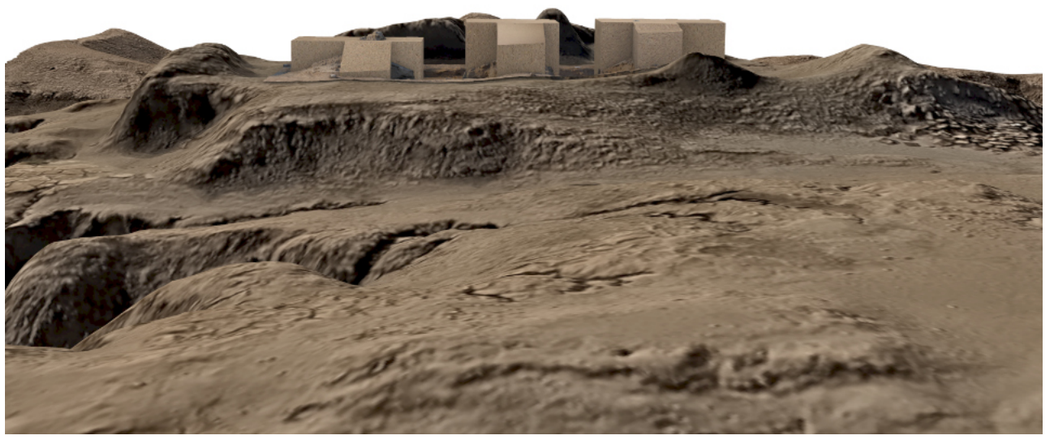

Concept phase – emergency-securing supplementary masonry
for the three findings of the NE central hall wall, view from NE
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Intercultural cooperation with Iraqi workers and
master masons from the region around Uruk
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