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Insights into Investigation and Building Conservation in the Old Village of Al Ḥārah Al Fawqā in Umm Qays, Jordan: Reconstructing the Historic Roof of Al Maḍāfah in Bayt Ar Rūsān

Introduction

The present paper discusses the extensive findings from the last eight years of German-Jordanian research and cultural preservation activities at the Gadara archaeological site in the village of Umm Qays. We address the interplay between research and practice, between teaching and learning, between understanding and questioning, and between analysis and experimentation. Our aim is to show that investigating historic building structures early on, as well as dialoguing and cooperating with the local community, may help to reduce construction errors during conservation work. This proactive approach also aids in the making of viable decisions in the context of restoration. We must emphasize, however, that many aspects of the historic construction process can only be determined during the restoration process, making the restoration itself a mode of experimentation.

Information about the Site

Al Ḥārah Al Fawqā ("Upper Village") is located in the eastern part of the ancient city of Gadara (FIG. 1), adjoining the modern village of Umm Qays. The residential development of Al Ḥārah Al Fawqā—still visible today—was built atop the ruins of Gadara, starting in the second half of the nineteenth century (Mershen and Knauf 1988: 137–145; Bührig 2019). The village was gradually expanded, modified, and rebuilt during the next hundred years. Today the village is uninhabited: its residents were resettled in the 1980s and are living in new houses in Umm Qays. Many buildings in Al Ḥārah Al Fawqā are in suboptimal condition; some have been destroyed, and most of the village remains abandoned. Some eight courtyard complexes have been rehabilitated and are in use as museum exhibits, administrative offices, cafes, and restaurants.

Al Hārah Al Fawqā has about fifty buildings, most of them only one storey, as well as a former school and a mosque. The buildings are made up of separately accessible individual rooms, arranged in rows. Some are grouped together, forming large courtyards, but there are also some detached one-room houses. Local building materials such as basalt and limestone characterize the appearance of the village, most of which were reused from the ruins of the nearby ancient buildings.

Training Programmes

A team from the German Archaeological Institute (DAI) in cooperation with the Jordanian Department of Antiquities has been conducting various training programmes and workshops in Gadara/Umm Qays and the surrounding villages since 2016 (Bührig 2019a; Bührig 2019b). Projects have included nine courses in stonemasonry and building preservation (see "Planning and Concept Development: Building Preservation as Training Program" in Bührig and Horn 2019). Local workers from the surrounding villages are introduced to the techniques of the craft, then gradually integrated into the restoration process and eventually employed to train others (FIG. 2)[1].

Ongoing Project in the Bayt Ar Rūsān

In 2017, the Jordanian Department of Antiquities granted permission for an abandoned and uninhabited farmhouse to be used for training courses. Bayt Ar Rūsān, south of the local museum, is slated to be sustainably converted into a work and training centre for crafts and building preservation.

The training courses have taken place in the courtyard and the eastern wing of this building complex since 2019. The Jordanian and Syrian course participants are learning basic stonemasonry skills and are applying them directly to the restoration work (FIG. 3). Led by experienced German artisans, the training courses are part of the important restoration work to save and recover the destroyed courtyard complex (Bührig and Horn 2019)[2]. All scientific knowledge gained is being incorporated into the planning and the work, with special attention to the application of local and historic building techniques.

Once completed, the courtyard will serve two functions: the rooms in the east will continue to be used as a training centre for crafts, while those to the north will be used for storage and training in archaeological finds processing. The rooms in the north wing and parts of the east wing have now been restored, and 2023 marks the first year that both course programmes are being held at this new location.

Al Madafah

The former meeting and reception room known as Al Madafah will serve as the centrepiece of the complex. Exhibitions, presentations, and other events will take place here. The aim is to provide

[1] All programmes are under the direction of Claudia Bührig and are financed by the German Federal Foreign Office as part of the Archaeological Heritage Network (ArcHerNet; see https://www.archernet.org). As of 2023 the programme is also part of the Ta'ziz partnership of the Federal Foreign Office. We would like to thank H.E. Dr. Fadi Bala'awi, director general of the DoA, and the DoA staff in Umm Qays for their support, particularly Moussa Melkawi and Ibrahim Roussan. We are especially grateful to all our participants and the Yarmouk Ladies, our local coordinator Ahmad Al Omari, and the people of Umm Qays.

[2] Special thanks go to the German artisans who provided training, above all Tobias Horn, Ronny Brühl, André Gravert, Florian Hess, and Peter Sistig. The programme could not have been brought to life without them.

a reception hall to present the results of the restoration work. In Al Maḏafah, the work from the field of cultural mediation and building conservation in Gadara/Umm Qays in general and the practical work in Bayt Ar Rūsān (as a training centre for building conservation and archaeological finds processing) in particular will be presented.

Al Maḏafah has a special position within the courtyard complex: it is the largest room and is directly accessible from the outside. Its central door is flanked by two windows. Al Maḏafah is so large that its roof is supported by three inserted arches, which divide the inside space into four areas. The floor of the front quarter is covered with basalt slabs.

Unused for years, Al Maḏafah was only preserved in parts (FIG. 4). The main façade in the north had almost completely collapsed, and the material had disappeared. The roof was preserved in parts but was in acute danger of collapse.

Information about the Building Documentation

Not only has a training course been established at Al Ḥārah Al Fawqā, but its buildings have also been surveyed, documented, and researched since 2017. We have endeavoured to provide a detailed record of these structures by documenting the increasingly endangered building stock, its history, and typological features.

Our documentation has included an analysis of the construction and design techniques as well as the materials used. Selected flat roof structures were examined by the archaeobotanist Reinder Neefs (Natural Science unit of the DAI, Berlin) to verify their organic components (Neefs and Kürschner 2017). At least three different roofing materials have been identified at Al Ḥārah Al Fawqā, in many variations.

Examples of Roof Structures in Al Ḥārah Al Fawqā and the Region

The flat roofs of Al Ḥārah Al Fawqā are supported by a main construction, which is made of either adjusted arches or iron rail spanning the interior. On top of these primary structural elements and running across them is a layer of bamboo stems, one row thick and carefully fixed together in parallel.

Reed mats are sometimes installed in place of or on top of the bamboo stems to increase the density of the layer. The material laid directly over this reed or bamboo layer varies and may consist of branches, dwarf shrubs, stems of high biennial flowering plants, and/or leftover straw. These additional organic layers form a shock absorber and isolation layer between the main structure and the solid roof slab made of a layer of dry earth or a dry earth/mud-packed layer (Neefs and Kürschner 2017: 2).

The entire roof structure is usually covered with a thin layer of lime sludge. In some cases, this is applied to a layer of flat small stones. Although some of their materials may vary, all flat roof structures follow the same principle: 1) main supports, 2) transverse secondary beams or reed mats [2a) reed mats, if secondary beams are not placed together tightly enough], 3) dwarf shrubs, plants, or straw remains, 4) packed earth or earth/mud, 5) top layer of lime sludge.

There are very few documented examples of similar flat roof constructions in the region. In his work *The Lebanese Dwelling House of the 18th and 19th Century*, Ragette (Ragette 1971: 13) describes similar roof structures built of five layers. A sectional drawing shows a stone roll as part of the roof, laid on top of it. In northwest Syria, Jäger documents a roof

construction with six layers and also explains some of the production process (Jäger 2012: 96; translated here from the German by the authors): "On the beams (*arka*) strong branches were laid as crossbeams (*bid*) and covered with smaller branches (*qas'a*) or reed mats in the opposite direction. On this a kind of herbaceous grass or foliage (*rūkaza*, also: *balān*) was spread and pressed with the addition of water. This created a dense layer, which was covered with soil (*trāb*) and straw chaff to a thickness of about 30 cm. Finally, a chalky or calcareous slurry (*ğis*) was applied as a top layer and compacted with stone rollers (*m'arğalāna*, locally also *maḥdala*) to form a rainproof skin. This top layer was smoothed after each rainstorm to maintain its impermeability. Slight slopes and gutters or swales assisted with roof drainage." The construction process is not explicitly discussed in any descriptions, however, nor is the function of the different components of the roof structure explained.

Al Madafah: Reconstruction of the Historic Roof Structure

We will discuss the reconstruction of Al Madafah roof in detail below in order to explain the interplay between investigation and construction, theory and praxis, and experimentation and knowledge. Our experience has demonstrated that the practical realization of the reconstruction provides missing information regarding the construction process and the building methods. This case study of the roof shows that is possible to prove the existing scientific knowledge and to understand the whole building process more completely by undertaking the tasks of reconstruction in real time.

Al Madafah of Bayt Ar Rūsān is one of the oldest roof structures in the village of Al Hārah Al Fawqā (FIG. 5). A lack of maintenance and proper drainage had left the roof in acute danger of collapse, and it had to be almost completely removed. The intention was to rebuild the roof in accordance with its historic construction, the record of which we have paraphrased here: Three arches provide the base roof structure, with tamarisk beams laid over these. The arches have little distance between them: the maximum length which the beams must bridge is only around two metres. The wood used for the beams is not of consistent quality, however: the heavy, short (max. *c.* three metres), and very irregularly shaped beams include relatively old tamarisk wood, from shrubs that were probably heavily damaged by pruning and livestock. Crosswise on the tamarisk beams is a layer of oleander branches. On top of this layer is matting or basketry, probably reeds (*Phragmites australis*) or *Arundo donax*. On top of the mats is a layer of *Sarcopoterium spinosum*, a very spiny dwarf shrub (Neefs and Kürschner 2017: 3–4, 17). On top of the reed mats is a densely packed layer of an earth mixture. The many years of neglect had left Al Madafah with a thick layer of humus on its roof, with grasses and flowers growing on its surface. It was therefore impossible for us to identify any final covering layer.

Even though we were able to clarify the exact structure of the roof, we still had many questions before beginning the reconstruction process. Important information about the production process was missing: the exact time sequence, the duration, the degree of compaction, favourable or unfavourable weather conditions, and whether the plants had to be brought in fresh or dried. Even the structural properties of the individual layers were not entirely clear at this point. The historic artisanal knowledge had been lost, and our team

had to rediscover it through experimentation.

The first step in the construction process was to produce a test roof that simulated the roof structure (FIG. 6). We tested how the materials behaved and determined their drying times. We also studied and tested the exact composition of the earth layers. Applying one layer per day proved to be practical. Watering the mixture before and after placing it on the roof gave us good results.

Constructing the Roof Structure

First, we debarked the tamarisk beams and laid them on the walls and arches, reusing the well-preserved beams from the original roof. Next, the oleander branches were laid on the tamarisk beams, followed by woven reed mats. The production of these mats had to be redeveloped, as this technique is no longer common in the region. We made a sample mat to optimize the production process and gave this template to the local basket-making cooperative, the Yarmouk Ladies[3]. Next came a layer of thorny burnet (*Sarcopoterium spinosum*), a plant that grows in the area. The plant had already flowered in October and the small bushes had almost completely dried out, so it could be used directly on the roof. Immediately on top of the thorn layer, we placed several earth layers, each with different mixtures. Once on the roof, the earth was watered and compacted layer by layer, with one new layer each day.

This compaction and levelling of the roof's surface was originally done with heavy basalt rollers, but no one in the village remembered using such a tool, so we commissioned new rollers from one of the stonemasons of the team. Local residents from the surrounding areas visited the site regularly while the work was going on; when they saw the rollers on the roof, they told us of how they now used similar tools to crush up old bread. Yet the original use of these tools had been forgotten. The rollers were no longer linked in the collective memory to the construction of a roof—until visitors saw these heavy stone tools in action (FIG. 7).

The last two layers of our reconstructed roof were made solely of earth, lime, and water. The fine components of the lime were gradually pressed upwards by the compaction of the rolling process; these particles formed a sintered layer resistant to water and weather.

All steps were carried out by two trained workers (see FIG. 7), who gained more experience as the construction process progressed. Towards the end, they developed an even finer sense for the characteristics of the construction and its materials. Now that the roof has been completed, both of these Umm Qays local residents have become qualified specialists in historic roof construction.

The missing façade and roof of Al Madafah (FIG. 8) were rebuilt in September and October 2021, the time of year when temperatures are moderate and solar radiation is relatively low (Zenker and Bührig 2022).

Monitoring

We inspected the roof structure in May 2022. The surface of the roof had remained almost undamaged through the rainy season; only at the edge and along the arches had cracks formed and allowed water to penetrate the interior. These cracks appeared for several reasons, but foremost that the smoothed

[3] In recent years, the Yarmouk Ladies have been trained in the historical techniques of reed- and basket-weaving as part of the training programme and now work independently at the site.

roof skin was not flexible enough to support the shifts caused by the shrinkage of the material.

The cracks occurred at the transition from roof to masonry because the roof structure has a different expansion behaviour than the hard stones in the masonry. The roof covering should therefore have been made flexible enough to compensate for this behaviour. Instead, however, the intensive compaction with stone rollers had hardened the surface as intended, creating a water-repellent layer: the material resisted any compressive load but was unable to absorb the tensile forces of the swinging roof, which in turn caused the cracking.

It became clear that the layer of thorns was originally applied to cushion the movements in the roof. In our reconstruction of the roof, we had underestimated the cushioning function of the thorns. The continuous compaction of the layers compressed the thorn layer to such an extent that a dense, almost monolithic roof was created. The whole roof had become an inflexible structure, and its inevitable movements could no longer be absorbed.

Although the material used corresponded in structure and composition to the materials identified in the historic roof structure, and the appropriate tools were also used, the compaction was too intense: it changed the structural interaction of the materials in such a way that consequential damage occurred. We addressed this by making a new recommendation that only the last layers should be compacted in order to maintain the flexibility of the materials, and we put this recommendation into practice. The cracks were closed to prevent any further water penetration. A new layer was applied to the roof, but first the whole surface had to be roughened to ensure a good connection with the new material. We will complete the roof in 2023, thanks to the participation of a great many workers, project stakeholders, and other partners.

Results

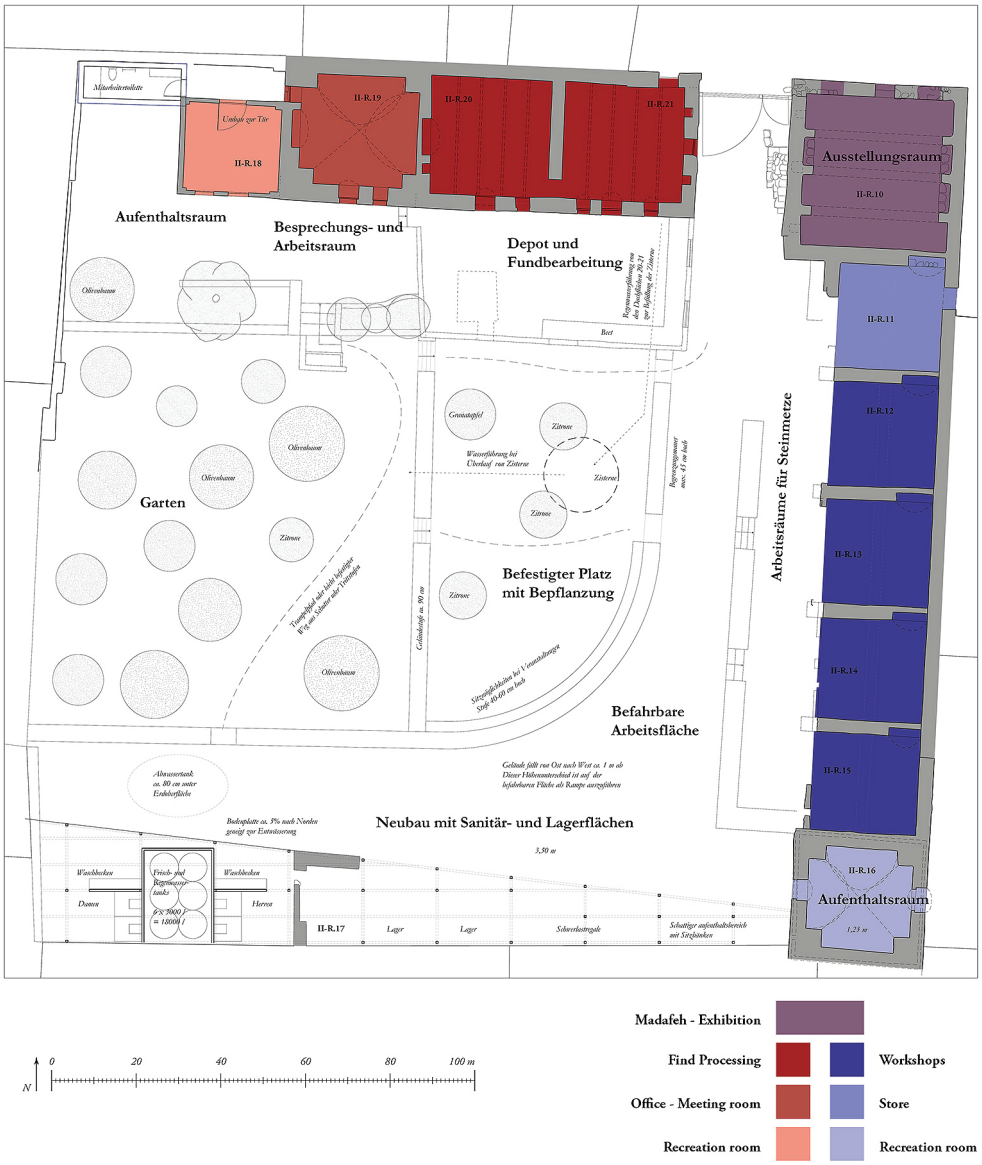
Using the reconstruction of the historic roof structure as an example, we wanted to show the importance of the interplay between research and practice. When we analyse the various steps involved in a reconstruction, we recover knowledge about the practical workflow on the construction site that has been lost and about the construction process as a whole.

Through the interaction of research and the practical application of that research, as well as through dialogue with the local community, we gained new scientific and practical knowledge about how Al Madafah was originally built. Our construction methods were continuously checked, commented upon, confirmed, discarded, and adapted by the artisans and workers involved. This practical evidence is essential because our knowledge about the building techniques, time sequences, type and quantity of tools required, and number of artisans necessary for such a project is in danger of being lost.

We will also consider these empirical values and approaches in our restoration work in the coming years, when we plan to renew the clay plaster in the interior of Al Madafah and other rooms according to the historical model. Some experiments and test plots using the materials available on site have already been carried out. We look forward to presenting the results of our efforts in a future work.

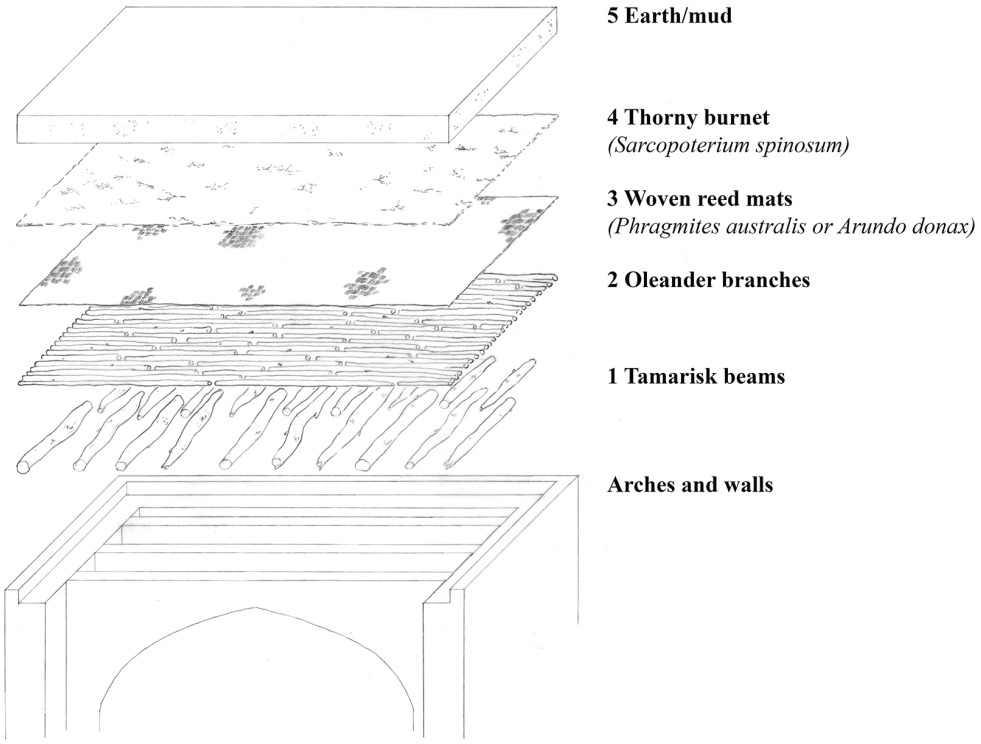
1. Gadara/Al Ḥārah Al Fawqā. Settlement hill. View from the south, 2003 (photo by Günther Schauerte.)

2. Al Ḥārah Al Fawqā. Group picture of the training programme participants in front of Al Maḍafah, taken at the topping-out ceremony in October 2021 (image by Olga Zenker, courtesy of DAI).



3. Al Ḥārah Al Fawqā. Bayt Ar Rūsān layout, 2022 (image by Christian Hartl-Reiter, Claudia Bührig, Olga Zenker, courtesy of DAI).

4. Al Ḥārah Al Fawqā. Al Maḏafah: condition of the historic roof structure, 2018 (photo by Peter Sistig, courtesy of DAI).



5. Al Maḏafah: Schematic illustration of the roof structure, 2017 (images by Helena Brinckmann, courtesy of DAI).

6. Al Ḥārah Al Fawqā. Al Maḍafah: Test roof, 2021 (photo by Olga Zenker, courtesy of DAI).

7. Al Hārah Al Fawqā. Al Maḍafah: Heavy basalt rollers compact and level the roof surface, October 2021 (photo by Claudia Bührig, courtesy of DAI).

8. Al Ḥārah Al Fawqā. Al Maḍafah: The condition of the roof before (spring 2018) and after the reconstruction, 2023 (photos by Claudia Bührig [top] and Olga Zenker [bottom], courtesy of DAI).

Bibliography

Bührig, C. 2019a. Archäologie als Bildungs- und Vermittlungsprojekt. Wissenstransfer zu und an dem historischen Ort Gadara/Umm Qays (Jordanien). Pp. 83–100 in A. Mollenhauer; M. Goussone and K. Lange (eds.), *Begegnungen. Archäologisches Erbe und soziale Praxis. Reflexionen aus Archäologie, Bauforschung und Ethnologie*. Berlin: Dietrich Reimer Verlag.

__ 2019b. Capacity Building in Gadara/Umm Qays (Jordan): Sustainable Development for Preservation of Historical Monuments and Knowledge: A Report. Pp. 637–652 in H. Hayajneh (ed.), *Cultural Heritage: At the Intersection of the Humanities and the Sciences. Proceedings of the International Humboldt-Kolleg (Jordan, 16–18 April 2019). Archäologie: Forschung und Wissenschaft* 7. Havertown: Lit Verlag.

Bührig, C., and Horn, T. 2022. *Stonemason Training: Capacity Building in Gadara/Umm Qays, Jordan* (English/ Arabic). Berlin: German Archaeological Institute.

Jäger, J. 2012. Wohn- und Bautraditionen im Wādī Al-Naḏāra. Erhalt und Weiterentwicklung. Doctoral diss., Technical University of Braunschweig.

Neefs, R. and Kürschner, H. 2017. Report on the Plant Material Used for Roof Building and Wall Temper in the 19th Century Ottoman Buildings in Gadara/Umm Qays (Jordan). Unpublished report. Umm Qays; Berlin: German Archaeological Institute, Orient-Department.

Mershen, B. and Knauf, E.A. 1988. From Ǧadar to Umm Qais. *Zeitschrift des Deutschen Palästina Vereins* 104:128–45.

Ragette, F. 1971. Das libanesische Wohnhaus es 18. und 19. Jahrhunderts. Doctoral diss., Vienna University of Technology.

Zenker, O., and Bührig, C. 2022. Umm Qays, Jordanien. Das Objekt im Blick. Untersuchung und experimenteller Nachbau. Bauwerkserhaltung im 'alten' Dorf von Umm Qays (Jordanien). Die Arbeiten des Jahres 2021. *e-Forschungsberichte des DAI 2022*, Faszikel 1:38–47. https://publications.dainst.org/journals/efb/article/view/3915/7612