Construction and decay of the copper age tombs in Oman

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Abstract

Along the old ways in Oman you can find numerous hemisphere-shaped stone buildings. The early of these constructions were built by the Hafit people (3000-2500 BC) and were used as tombs. Today these graves are the oldest buildings in the whole country. All tombs were built with locally available hewn stones with a filling of sand, clay and small stones between the externally and internal skin. The semi spherical shape is achieved by the building of a cantilever cupola with a layer of gravel above it. The walls were carried out in a mostly double-shell way. The preparation of a grave was something very extensive during the copper age, so that the burial in such a grave was reserved for outstanding personalities. The numerous grave additions which were found during archaeological excavations prove this. The tombs were placed to a large extent at visible places and near settlements, according to which they were to the living a memorial. Over the centuries their design and appearance changed. New findings in stone processing and wall techniques let the buildings become more constant.

Due to climatic influences and unfortunately to stone robbery numerous graves are endangered in their stability. This article describes the different design forms and introduces the constructive failure mechanisms of the tombs.
Keywords: tomb, copper age, Oman, cupola, masonry.

1 Introduction

The culture of the population in Oman between 3000 and 2000 B.C. is relatively little known today. In the first place the available information is based on investigations of the burial rites and metal workmanship. Only since 1958 has the archaeological exploration of this time begun through a Danish expedition [1]. Since then numerous archaeological expeditions were carried out mainly



from Denmark, Great Britain, Italy and Germany. The investigation of the mysterious tombs often stood in the foreground. Today there are numerous excavation results and drawings of the graves existence. At some Um an Nar graves a reconstruction has been started. Until now there have been no considerations about the preservation of these important witnesses of the oldest known culture in Oman. In this article the constructive forms and damages of the tombs are shown. Possibilities for the maintenance of these buildings are identified.

2 Tomb types of the copper age

2.1 Hafit

The name of this type is based onto the place where the first graves have been excavated. These tombs stand at the bottom of the Jebal (= mountain) Hafit [1]. This construction form arose between 3000 and 25000 BC. The tombs are overground circular grave buildings. Their diameter reaches from 4 up to 8 meters. The tombs reach a height of 2 to 2,5 meters. Hafit graves are arranged mostly on Wadi terraces or running out slopes. The round or oval formed tomb chamber inside the construction has a diameter of 1 up to 2,5 meters. This chamber is constructed by a cantilever cupola with a layer of gravel above it. The entire construction is build with quarrystones from the very near environment. The stones were worked upon only insignificantly. The outer skin has therefore a very rough form.

At numerous graves the cupola begins in about 1 m height above the ground so that a beehive-shaped form arises. These types are correspondingly called "beehive graves".

During the preparation of the walls both stretcher and header bonds have been used. A wall consists of an interior and an exterior skin. The space in between is filled up with a sand, soil and gravel mixture. Binding components in this filling could not be found.

The entries are about 1 meter high and have a diameter of less than 60 cm. Some of these lineal ways get smaller to the interior. Rectangular entries are common but three-angled are also existent. At the rectangular forms big stone plates are used as lintels. The three-angled ones are built out with a cantilever arch.

2.2 Umm an Nar

Correspondently to the Hafit tombs the Umm an Nar tombs are named by the place where this construction has been excavated in the first time. This took place on the Umm an Nar island near to Abu Dhabi by a Danish expedition [1]. The tombs have also a circular outline. The grave interior is subdivided by walls in two or more chambers. The interior walls give more stability to the construction, so that the diameter reaches from 5 up to 12,5m. The exterior wall



Figure 1: Beehive tombs Al Ain.



Figure 2: Wall construction.

is always a one-leaf construction. For a better appearance the Umm an Nar tombs are finished with fine smooth stones on the outside. Some tombs have layers with white stones, the so called “sugar lumbs”. These graves have been used for multiple and collective burials. The Umm an Nar are provided with two entries which led into separated or combined chambers. The wall building technique in the Umm an Nar period was advanced visibly to the technique of the Hafit age. The stones of the outer shell are incorporated much better. The Umm an Nar people already worked with bonds.



Figure 3: Umm an Nar tomb in Bat with two chambers and a interior wall.

2.3 Tower tombs

The tower tombs at Shir are also dated to the Umm an Nar period but they have a different construction [2]. They have a frustum shape and reach a height of 5m. These towers have also a cantilever cupola inside. Sometimes there are also two cambers inside one tower. It is not to be excluded that also other Umm an Nar graves showed this tower form before.

3 Destructive elements

3.1 Plunderer

All graves are placed at to a large extent recognizable places near to settlements. Sooner or later almost all graves were robbed in the past. The graves have been opened from above, because it was not always recognizable at which place the

entry was found. This required a lot of work, because first up to 1,5meter stone material has to be removed before you can reach the chamber. The Tombs remained opened afterwards. Their structure has been damaged and it is only a question of time until the structure collapses completely. Particularly when grazing cattle or people will climb onto the tombs this destructive process speeds up.



Figure 4: Tower tomb at Shir.



Figure 5: Collapsed cupola inside a tower tomb.

3.2 Weather

The tombs were build mostly with dry stone walls. Between the interior and exterior skin the walls are filled with a sand, soil and gravel mixture. The millenniums lasting weathering through wind and rain led to different modifications within this fillings. At most of the areas the filling was rinsed and the stones lost their fixed hold within the wall grain texture. A destabilisation of such masonry sections is the result. At other places the filling compacted and presses the walls apart. The stones hold only due to theirfrictional forces under each other. If the overlapping of the stones is too small this frictional force is low and buckling arises easily in grain texture.

3.3 Stone robbery

The stone plunder represents the by far greatest problem today. In the course of an immense boom in construction activity in Oman the graves are employed to the part as favourable quarries. Here one can obtain slightly already slammed stones. It can be observed that the graves slightly attainable with a truck are removed more strongly, as the graves in steeper situations. In the lower terraces traces of twin tires are also often seen in near to the graves.

4 Significant forms of destruction

4.1 Collapse of external wall

The tombs were provided often with an additional skin. This bowl was placed before and/or on the inner dome. No combination was between inner and external skin designated. Through the steep form and the lacking compound with the sub-structure the hole cupola dissolve easily. A damage place in this masonry serves fast for the breaking off of further stones as an attack point.

4.2 Buckling

In the course of compressions or washing out of the filling material it results in raised pressures with the double-leaf masonry. The dry masonry can only offer the frictional force to these pressures in the horizontal joints. If the overlapping is too small or the stone is not in contact with the other stones anymore parts of the walls are buckling or drifting apart.

4.3 Collapse of substructures

Through the modification of the carrying-structure due to stone removal the carrying-system is not anymore intact at many graves. The partial carrying-systems been left did not bear up the loads anymore and do fail easily. In the many cases the functionality of the cantilever cupola was disturbed by the removal of the stone fillings. This cause the collapse of the tomb chamber dome even by small loads.



Figure 6: Collapsed external wall.



Figure 7: Buckling in a wall.

4.4 Stone damages

The stones of the free standing Hafit and Umm an Nar graves are exposed to most extremely high climatic demands. Strong heat on day and cool nights cause very strong fluctuations of temperature. During the introduction of rain the burdening cooling process runs even faster. Cracks inside the stones are the result. Also the continuous demand on wind in particular in touch with wind-borne sand leaves his traces at the facades in the form of stone erosion.

5 Measurements

5.1 Fencing

To avoid a further destruction of the graves through stone robbery and climbing of persons, the areas in which the graves are have to be shut off. On advising of the German Mining Museum the Ministry of Antiquities started to shut the site of Bat. A complete closing of all the areas with corresponding control would be desirable.

5.2 Fillings

Many stones are not in the compound with the surrounding masonry. Single stones can be detached easily. These stones do not carry the loads of the construction. Around the entire construction all stones should stabilize again into a mortar bed. To that the embankment would be to be developed between the wall layers again. According to the historical model a clay mortar should be used again. For the distinction of the original substance and for the reaching of a higher permanence however a compatible binding component should be added (for example lime).

5.3 Reconstruction

Many graves are faulty in such a way that a repair is not anymore possible. From the remained stones should occur at the one or other place a reconstruction of a grave. Described as above there were many different forms and architectural elements. It should be well discussed with the archaeologists which representative form has to be reconstructed.

6 Conclusion

The Hafit and Umm an Nar tombs are today the oldest buildings of Oman. They represent an important cultural heritage of the Omani Population. Unfortunately these buildings are endangered in their existence. Grave and stone robber, one millenniums lasting weathering, the of maintenance operations, however, also the visitors endanger these constructions. With relatively small expenditure the graves can be protected. Just even small masonry repairs and a shutting of the sites can cause a big positive effect. Furthermore a tomb has to be reconstructed in order to represent the initial appearance of these graves to the population and to keep on stimulating the interest in this culture again.

References

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