

EXPERIMENTS IN MUDBRICK CONSERVATION AT TEPE NUSH-I JAN

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SUMMARY

Efforts to conserve the Median site of Tepe Nush-i Jan (north west Iran) have been made since excavation began in 1967.

In this paper I outline the particular damage and decay being suffered by the site's monumental mudbrick buildings, then describe the different techniques adopted and discuss their effectiveness.

I have also included the results of laboratory tests identifying the constituents of brick samples collected when I visited Tepe Nush-i Jan in August 1978.

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The experiments in mudbrick conservation carried out on Tepe Nush-i Jan, the Median settlement in the central Zagros region of Iran were first reported on at the Yazd conference in 1972 by David Stronach, the Director of the British Institute of Persian studies. The present paper is the result of my visit to the site in August 1978.

In 1977, the most recent year of excavation since work was begun in 1967 by the Institute, Tepe Nush-i Jan would appear to consist of four major buildings built on the summit of a natural shale outcrop. The outcrop is about 37 meters high and is situated on the fertile Malayer-Jowkar plain, 70 kilometers south of Hamadan.

The area at the top of the mound measures 80 x 30 meters and the buildings erected on it include a Fort, a central Temple, a Western building, and a Columned Hall. They are of monumental proportions with walls standing at 8 meters high now, but probably at 13 meters originally. To accommodate the height, the walls are 1.80 meters wide at base. Round these buildings further structures have been discovered including storage magazines, a North building and on the south and west sides of the site at least, an encircling wall decorated with arches on its inner face. At the centre of the mound, the walls and floors rest on bedrock (the depth of the mudbrick floor being only 25 cms. deep). Elsewhere however, they stand on a mudbrick platform which was constructed to compensate for the unevenness of the mound's summit. Thus, the platform is level with bedrock near the center of the mound but at its outer limits it achieves a height of 2.70 m. (eg. at the south east corner of the fort). Below the floor of the Columned Hall, about three meters below floor level is a rock cut tunnel descending westwards for about 20 m. at an angle of 30 degrees.

Building and occupation of this site lasted for about 150 years from c. 750 B.C. to 600 B.C. when it was abandoned. Although the site was occupied briefly in Achaemenian and Parthian times, there was no further monumental construction. Today, Tepe Nush-i Jan presents not only diverse examples of mudbrick construction, due to the remarkable extent to which the Medes relied on mudbrick as a building material (1), but

it also includes in the Central Temple a unique type of Iranian vaulting characteristic throughout the Median era (2). Furthermore this is still largely intact because prior to abandonment, the occupants filled up the Central Temple with layers of shale and mudbrick and blocked up other parts of the site.

I collected samples of the mudbrick used at Tepe Nush-i Jan and took them to Tehran to be analysed (3). The samples were taken from the blocking at the eastern end of the site. This location was chosen because the bricks here had not been subject to external weathering ever since Median times, being well below the surface and they were therefore in a state of optimum preservation.

The following results were recorded (4):

Shape: rectangular
 Size: 40 x 25 x 30 cms.
 Weight: 19.50 kilos
 Density: 1.5 kilos per cubic cm.
 Composition:
 Clay: 15%
 Silt: 47%
 Sand: 34%
 Gravel: 15%

N.B. It is important to note that the composition of the bricks used at Tepe Nush-i Jan is not uniform. Bricks from the blocking in the east court area used above characteristically contain little shale, in contrast to the Fort where the shale content is very high. Interestingly, the shale content is also particularly high in the lower courses of the walls which suggests that some special advantage was thought to be attached to this.

Fibrous Material: Chopped straw.

This was identified when the brick was saturated with water and disintegrated. Externally this could be deduced from the tiny hollow shells remaining in the brick.

Non-fibrous Organic Material: Pieces of wood
 Charcoal

Rough Inorganic Additions: Occasionally shards
 Much shale, a heavy mixture of
 small pieces.
 Quartz pieces.
 Mica.

Permeability of the foundation material: Very permeable.

There is rising damp from underneath the mudbrick platforms near the surface of the mound up to a height of 1.30 m. in the lower parts of the walls.

Liquid limit: 27%

Mortar: Mud mortar was the only type of mortar used and it contains no organic material. Both brick and mortar are equally subject to spalling and there is no difference in terms of resistance to erosion.

Other materials used:

Whilst the Medes appear to have used mudbrick struts to span areas up to 2.50 m. across, for anything larger and for the columns in the Columned Hall, imported timber was used. No timber now remains.

There is a very small amount of plaster work covering, e.g. the hemi-spherical firebowl in the Central Temple. The firebowl itself is mudbrick and is covered with several layers of fine white plaster.

However, from the point of view of conservation, this is insignificant in relation to the very great need to tackle the progressive damage being suffered by the mudbrick structure itself.

The most difficult problems are being caused by:

1. Rising damp from beneath the mudbrick platforms up to a height of 1.30 m. in the walls. This produces salt efflorescences and spalling or loss of face to a depth of 18 - 20 cms.
2. The impact of wind-driven rain affecting the site's south western aspects in particular.
3. Cracking walls as a result of structural movements. Although the area is one of seismic instability, this particular damage is not being caused by earth tremors, but by a general drying of the surfaces since excavation.
4. Overall decay also caused by surface dehydration is particularly noticeable on the upper walls exposed to most wind. Crumbling and pitted walls are unfortunately recognisable throughout the site.

Damage is also caused by:

- (a) Pigeons: a particular menace because they roost in any crack or animal hole they can find. In antiquity large cats and scavengers excavated layers in places.
- (b) Snow: two measures have been taken to alleviate the serious erosion that is caused to the base of the walls when snow accumulates.

(i) the construction of protective steel roofs in 1974 (see below).

(ii) the appointment of a guardian one of whose duties is to shovel away snow.

- (c) Visitors: surface erosion and damage is caused by the passing of people's feet, hands and shoulders as they brush against the sides of doors etc.

N.B. There has only been one severe case of malicious damage by visitors when the bricks of a low protective mudbrick wall around the deep void of the Central Temple were hurled onto the floor of the cellar, causing damage to the floor and to parts of the mudbrick altar.

Efforts to conserve the site at Tepe Nush-i Jan have been made since excavation began.

At first these were limited to either reburial of excavated structures or where this was impractical, to the addition of thick coats of mud plaster (kaghel).

The first six months made it clear however that mud plaster was insufficient by itself to protect against the severity of the Hamadan climate. In winter temperatures drop to -30°F (-34°C) with snow and heavy frost. At other times of the year wind and driving rain must be contended with, whilst in summer it is hot and dry with temperatures around 100°F (38°C). The prevailing winds come from the south west.

In view of this, in August 1970 experiments were carried out using Epikote lacquers as a method of conservation. Two types of lacquer were developed by the Egham Research Laboratories of Shell Research Limited, London and brought out to the site to be tested:

- (a) a two component lacquer applied by brush (5)
- (b) a heavier two component trowelling composition using mudbrick dust as a filler.

In both cases the chemicals applied impregnated the walls up to a depth of 0.5 cms. and the lacquered surfaces acquired a "stone-like hardness".

Although the treated areas mostly resisted wind and water erosion for two winters, subsequently the extremes of temperature have caused the hard surface to peel off sometimes taking other parts of the wall with it. In order to cope with the effects of thermo expansion and contraction it would seem that much deeper penetration would be necessary: David Stronach suggested to me possibly 5 cms.

Various methods have been employed to protect the larger standing walls.

The brickwork exposed to maximum wind and rain is plastered with a protective skin of kaghel. Elsewhere the walls are

not so protected but instead are capped by layers of stiff reed mats and kaghel, with a layer of guni (sacking soaked in tar or similar bituminous material) laid between. The latter acts as a form of damp course. Wooden slats extend the capping beyond the width of the wall. This method is useful because it is flexible enough to follow the contours of uneven wall surfaces and it has proved to be efficient.

Standard village roofing techniques have been used to protect some of the excavation trenches temporarily. These consist of long wooden poles with smaller cross struts supporting reed matting and kaghel. For extra protection polythene, perforated to prevent condensation, is laid over the first layer of mud and below a second layer.

Where walls have been damaged by erosion, pitting or other types of disturbance and where the appearance of the original wall is certain-Median bricks from the blocked areas of the site are used to build up the line of the walls. It is proposed that all reconstituted areas be demarcated using a thin line as has been done at Masada. Replacement of damaged brickwork helps alleviate further erosion and weather damage in general.

To protect the floors of the large open excavated areas, a layer of sacking is first laid down and then a backfill of up to 40 cms. of earth is added.

In 1974 Silurian steel roofs (28 x 24 m.) on free-standing columns about 7 m. in height were erected over the site. These have been very important in the conservation of the site because they guard against the serious damage caused by rain, snow and the impact of run-off water. Gutters are attached to the roofs and the water collected runs down closed drainpipes. Initially vertical, these drainpipes then slope gently underneath the visitors' walks to the edge of the mound so that the run-off is carried away from the buildings. The pipes are buried because if exposed, they tend to be damaged, displaced or removed altogether and catastrophic results follow.

Finally, a local custodian has been appointed to oversee the site, to be alert to visitors and perform such duties as clearing accumulated snow.

Although the measures taken to protect Tepe Nush-i Jan have succeeded as far as they go, they are nevertheless inadequate to deal with the problems outlined earlier.

For example, whilst the steel roofing holds off vertical rain and snow, wind still blows through persistently. Even though wind erosion itself is slight, nothing prevents the worsening of the cracking and decay being caused by the effects of general dehydration which result. Neither are the problems of rising damp, wind, driving rain or pigeons dealt with.

It is suggested by David Stronach that the central area of the site should be covered with kaghel to preserve the structure. The drawback here of course is that the facade is altered. (The walls at Tepe Nush-i Jan have no overall coating of kaghel so that the masonry is left exposed.)

In conclusion, if Tepe Nush-i Jan is to be saved from irrevocable disintegration it is clear from the above that there is an immediate need to take further action. Not only is it necessary to find a more comprehensive method of protecting the buildings but it is also equally important to find one that does not disguise or detract from their original appearance.

NOTES

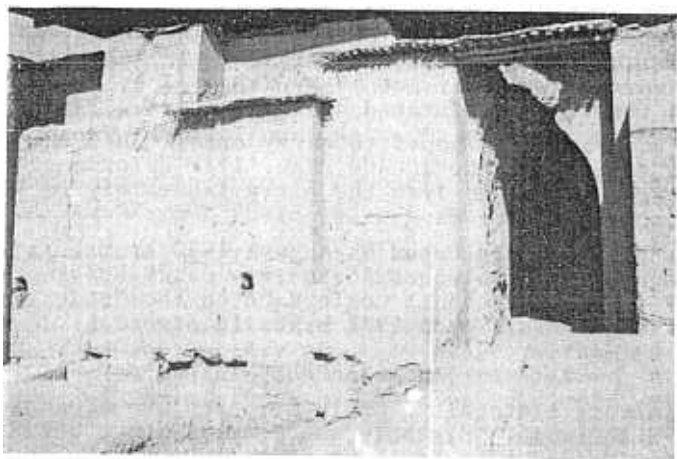
1. A full description of the mudbrick architecture discovered at Tepe Nush-i Jan may be found in the Iran Journal vols. VII (1969), XI (1975) and (1978). There have now been five seasons of excavation.
2. This type of vaulting is made up of "two opposed sets of curved mudbrick struts which spring from each of the long walls and meet in the middle of the room". Iran Journal vol. 19. It is a highly unusual method possibly beginning with the Medes. It became important in Iran and is illustrated in later buildings of the Achamaedians at Persepolis, of the Parthians at Shahr-i Qumis (Damghan) and at Kuh-i Khwaja in Sistan, a combination of Parthian and Sassanian.
3. The laboratories of the Mandro Co., 19 Amir Atabak Ave., Teheran were very kindly put at my disposal by Dr. Amir Soleimani and the tests supervised by Dr. Razmara.
4. I had originally hoped to carry out in full the Questionnaire No. 3 prepared by ICCROM (Rev. 2). Unfortunately, due to political events in Iran the extra laboratory facilities required could not be made available.
5. The field trials begun in August 1970 by Mr. David Booker of the Egham Research Laboratories are described in the report of the First International Conference on the Conservation of Mudbrick Monuments (Yazd) 1972 by David Stronach.

ACKNOWLEDGEMENTS

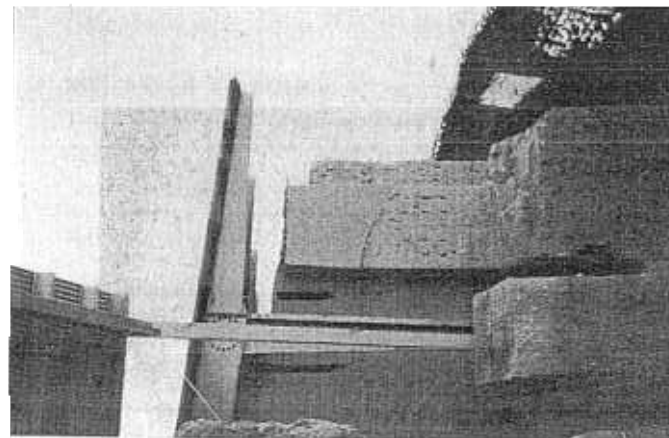
I am very grateful to David Stronach who accompanied me to Tepe Nush-i Jan. His help and comments have been invaluable. I would also like to thank Richard Hughes for his assistance.



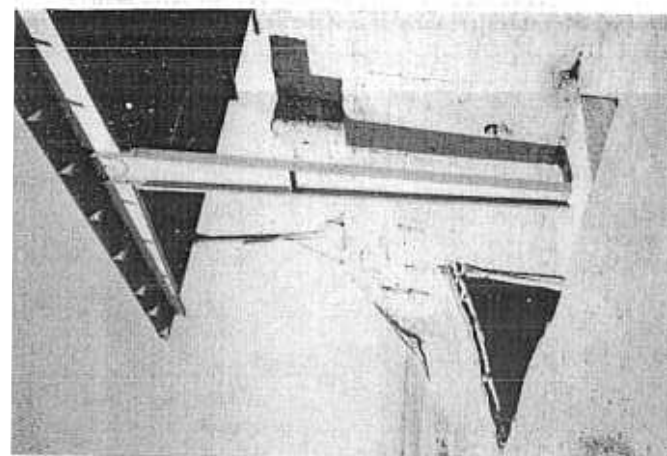
Tepe Nush-i Jan
 Situated on the Malayer-Jowkar plain 70 km. south of Hamadan



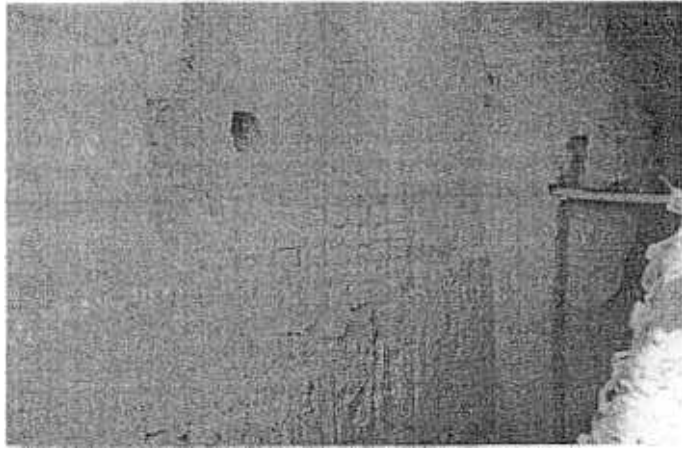
Damage caused by animal scavengers in lower parts of walls
 Conservation efforts:
 Note a) replacement of brickwork where original appearance certain
 b) protective coating of mudplaster (kaghel)
 c) protective roofing using reed and kaghel, extended beyond the limits of the walls by wooden slats.



Illustrating a) steel roofs
 b) replacements of brickwork
 c) protective coating of kaghel



Siluran steel roofing on free-standing columns
 Note drainpipe system for carrying water away from the buildings.
 Also: standart village roofing temporarily protecting trenches.



Surface spa

interior

