

Nº	Address	Use	Flooding Risk	Heritage value
1	Peña Pobre, 64	Collective housing	High	Medium
2	Empedrado, 215	Building of the Alejo Carpentier Foundation	High	High
3	Cuba, 221	Collective housing	High	Medium
4	Obrapía, 158-160	Museum building	Medium	High
5	Oficios, 53	Hostel building	High	High
6	Lamparilla, 9	Bldg. in repair	Medium	Medium
7	Mercaderes, 257	Bldg. in repair	Medium	Medium
8	San Ignacio, 703	Individual housing	Medium	Medium
9	San Ignacio, 705	Individual housing	Medium	Medium
10	San Ignacio, 709	Carpentry Bldg	Medium	Medium

Table 1. Details of rammed-earth buildings in the flood area (credits: Raimundo de la Cruz, Plan Maestro de la oficina del Historiador de la Ciudad de la Habana, 2011)

5. RAMMED-EARTH CONSTRUCTION

Out of a total of 24 rammed-earth buildings identified around the town, ten of them or 40% of the total are located in the flood zone. Of these, four are located in the most vulnerable primary sector. In each case, research needs to occur, to review if there is lime stabilization, in order to pinpoint the most vulnerable buildings.

The Alejo Carpentier Foundation, originally the residence of the Countess of La Reunion, and the Valencia Hostal, a former residence of Count Casa Moré, is found in the primary flood zone and is of high heritage value. The Museum Obrapía House is equally important, but is located in the secondary sector. In this area, on the Puerto Avenue, the Russian Orthodox Cathedral was built using typical details of gold onion-shaped domes; it has become a new and controversial touristic curiosity.

Notes

- (1) According to the estimate by a team of oceanographers, sea-level rise would be 31.14 cm in 2050 and 84.92 cm in 2100.
- (2) According to estimates in 2050, 2,550 km² would be submerged throughout the Cuban archipelago; this area would reach 5,994 km2 in 2010, representing 2.32% and 5.4% of the land area, respectively.
- (3) Formerly the docking area for daily-service ferries to Florida, USA.

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6. CONCLUSIONS

Different strategies from those established for the historic center are required, aiming at these most vulnerable areas. Moreover, residents and/or users must be sensitized for these special conditions. These strategies should embody two different proposals: one, aiming at the heritage and infrastructure construction located in the primary and secondary flood-zone areas and suitable to their material vulnerability; and another one, appropriate for the remaining buildings and infrastructure in the same area.

6.1 Recommendations

- The following are the recommendations for further research based on this study:
- A more detailed topographic survey of the flood areas is required.
  - There is a need to study at greater depth the effects caused by climate change on the Historic Center.
  - A redesign of the urban drainage towards the coast is necessary, taking into consideration the increasing flow caused by heavier rains, combined with the possible incursion of the sea at the extreme northwest.
  - A study of the moisture composition and resistance of rammed earth is needed, taking into account the possibility of an original stabilization with lime, and putting forward suitable protection actions.
  - The inclusion, in current and future investment tasks for the area, of a paragraph with the duty to mitigate damage from flooding is required.
  - The promotion of discussion and dissemination of this issue to institutions and the population of the area is necessary, in order to incorporate contingency plans that should be drawn up to counteract the various kinds of negative effects from floods.

AL-TURAIK DISTRICT OF AL-DIR’YAH, SAUDI ARABIA: WORLD HERITAGE SITE FACING PERIODIC EXTREME WEATHER EVENTS

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Theme 2: World Heritage Earthen-Architectural Sites, Natural Disasters and Climate Change  
Keywords: Al-Dir’iyah, violent rain, sand storms, risk preparedness, disaster response

Abstract

Al-Turaif district of al-Dir’iyah in the Kingdom of Saudi Arabia on the outskirts of Riyadh was inscribed on the World Heritage List in 2010. Al-Turaif site covers approximately 29 hectares with a buffer zone of 238. Nominated under criteria iv, v and vi, the site is an outstanding example of a Najdi settlement, a significant human settlement in a desert environment intimately linked to the adjacent Wadi Hanifah (a dry riverbed), site of the first two Saud States, and connected to the teaching of the Islamic reformer who lived there, Sheikh Mohammad Bin Abdul Wahab.

Dating to the 15<sup>th</sup> century, the site was deliberately destroyed in 1819 by the Ottomans. As such its current state is that of a mud-brick ruin, extraordinarily evocative both for its size and detail, but also for the beauty of its setting within the Arabian plateau landscape. Located at the crest of the escarpment, the area receives very little annual rainfall. However, when there is precipitation, it typically arrives as violent rain events. There are also periodic sandstorms that “sand-blast” the structures. The site is extremely vulnerable to both of these phenomena, because of the steepness of the topography, the ephemeral nature of the construction material that requires cyclic renewal, and the incompleteness of the architecture, no longer being roofed or having the capacity to shed water.

This paper will describe the significance of the site, its physical nature, and the risks to its survival. It will propose environmental monitoring together with conservation measures that will improve risk preparedness and disaster response. Most of the conservation methods are specific to mud-brick ruins, but the paper will also include the proposed mobilization of civil society as a tool for use in risk preparedness and disaster response that is applicable to heritage sites in general.

1. INTRODUCTION

From 19-20 February 2011, the authors participated in a two-day workshop that included several international experts (1), representatives of the Saudi Commission for Tourism and Antiquities (SCTA) (2), and the Arriyadh Development Authority (ADA) (3). The purpose of the workshop was to review conditions and provide recommendations for the treatment of al-Turaif district (Fig. 1) at the site of al-Dir’iyah on the outskirts of Riyadh along the Wadi Hanifah, which was added to the World Heritage List in 2010.

2. BACKGROUND

2.1 Brief History

It is known that Wadi Hanifah has been inhabited for at least 80,000 years. Although no Neolithic sites have been found at al-Dir’iyah, it is likely they existed. It is also believed that by the 3<sup>rd</sup> millennium BCE, oasis farming developed in Wadi Hanifah.

Written sources attest to settlements in the Riyadh area during the Classical period of the Mediterranean (500 BCE).

In pre-Islamic times, the area around the Wadi was cultivated, and prospered until the decline of the Roman Empire, the advent of Christianity, and the lessening of the demand for incense. As settlements weakened, nomadic tribes rose to power. A centralized government appeared between the 5<sup>th</sup> and 6<sup>th</sup> centuries CE, but Christianity was defeated in 634 CE in a battle to the north of Wadi Hanifah.

The Umayyad Dynasty took control of the area in 692 CE. However, after the last Abbasid campaign in the 9<sup>th</sup> century, the area reverted to local rule. By the 10<sup>th</sup> century, the region became part of the route to Mecca. In the two succeeding centuries, the area was prosperous, eventually developing the Najd settlements in the 15<sup>th</sup> century, of which also dates the origins of al-Dir’iyah. In 1446, Ibn Dir’, the chief, invited his relatives from the Gulf Coast to inhabit the farmlands,



Fig.1 Al-Turath district in al-Dir'iyah was added to the World Heritage List in 2010 (credits: Pamela Jerome, 2011)

and the Muradah founded al-Dir'iyah. The influence of Islam became stronger with the growth of religious advisors.

By 1600, the population reached its peak. The Ottomans also made an appearance. In the 16<sup>th</sup> and 17<sup>th</sup> centuries, two rival clans emerged, al-Muqrin and al-Wataban. The clans migrated to opposite sides of the Wadi, and the chiefs came mostly from the latter clan. This changed when Mohammad Bin Saud (1788-1818) of al-Muqrin assumed power and founded the House of Saud. As urbanization increased, so did the desire for appropriate governance, providing fertile ground for the great reformer, Sheikh Mohammad Bin Abdul Wahab.

Sheikh Mohammad Bin Abdul Wahab, born in 1703 in Najd, studied from an early age the teachings of the Prophet, and subsequently sought to restore the pure principles of Islam. Mohammad Bin Saud officially accepted his teachings in 1745 and the First Saud State was founded in al-Dir'iyah based on sharia law. This changed the course of Arabian history.

Al-Dir'iyah encompassed several villages, including al-Turaif, which by the late 17<sup>th</sup> century had become the most important town. From 1745-1790, al-Dir'iyah held authority over Najd, and was the seat of the Reform message of Sheikh Mohammad Bin Abdul Wahab until 1810. During this time, Al-Turaif evolved into the center of the First Saud State, with administrative complexes and palaces for the Saudi princes, of which the largest is the Salwa palace with a plan of 10,000 square meters.

Al-Dir'iyah fell in 1818 to the Ottomans, ending the First Saud State, and the following year, al-Dir'iyah was deliberately destroyed. Partially rebuilt, it was demolished for a second time in 1821. Sheikh Abdul Wahab's sons and Turki Bin Abdullah al-Saud ousted the Ottomans, establishing Riyadh as the capital of the Second Saud State in 1824. Al-Dir'iyah remained in ruins (Al-Aidaros, 2009, pp. 40-49).



Fig.2 A wide variety of historic Najdi architecture is found on the site (credits: Pamela Jerome, 2011)

Fig.3 One of the authors standing next to a high stone foundation for scale. These provide traditional flood protection for the mud-brick superstructures (credits: Pamela Jerome, 2011)

## 2.2 Significance

Inscription of the site onto the World Heritage List in 2010 was justified under the following criteria:

(iv) *an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history*

Constructed of mud bricks on limestone foundations, the ruins of al-Turaif are the most impressive of al-Dir'iyah, illustrating homogeneity of scale, some of the finest examples, as well as the variety and extent of Najdi architectural styles, and the appropriateness of the architecture to the harsh conditions of the local climate and topography. They provide a unique example of Najdi architecture.

(v) *an outstanding example of a traditional human settlement, land use, or sea use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change*

Al-Turaif is an outstanding example of an oasis settlement, demonstrating the organic development between the environment, its resources and the architecture's construction materials.

(vi) *be directly or intangibly associated with events or living traditions, with ideas, or with beliefs, with artistic or literary works of outstanding universal significance*

Al-Turaif is directly associated with the Islamic reformer, Sheikh Abdul Wahab, who lived and taught there. His teachings brought stability, while his concepts had a major influence on subsequent reformers (Al-Aidaros, 2009, pp. 53-56).

## 2.3 Description

Al-Turaif lies on the top of the escarpment overlooking the edge of Wadi Hanifah (4). The urban site, a mud-brick ruin, incorporates 29 hectares with a buffer zone of 238 (Al-Aidaros, 2009, p. 22). Al-Turaif is extraordinarily evocative in its setting and spirit of place. The textures of the different types and phases of construction, as well as the beauty of the



Fig.4 Textures vary at the site and are an important aesthetic that should be protected (credits: Pamela Jerome, 2011)

landscape and traditional Najdi architecture, also contribute to the remarkable aesthetic qualities of the site.

Thus far, extensive research and documentation have been achieved, including archaeological excavation and the recording of oral histories. Low-impact shoring has been installed to provide temporary structural stability. A management plan (Kingdom of Saudi Arabia, 2009), approved master plan (Lord Cultural Resources, 2008), conservation manual (CRAterre, 2008), and detailed construction drawings have been prepared, the latter not only for stabilization of the site, but also for a series of museums of respectful scale carefully inserted into the ruins, as well as elevated walkways that appropriately isolate the visitor from physical contact with the site (Ayers Saint Gross, 2008).

## 3. THREATS AND REMEDIATION

Like all exposed archaeological sites, al-Turaif is threatened by the incompleteness of its architecture, no longer having the components that provide it with the capacity to shed water. Although Wadi Hanifah is a dry riverbed in a very arid environment, the site is prone to severe weather events in the form of violent rain (Al-Aidaros, 2009, p. 85) and sandstorms. In addition, the ephemeral nature of the construction material, requiring periodic renewal of sacrificial plasters, as well as the steepness of the site, make it particularly prone to degradation by either of these phenomena.

### 3.1 Proposed conservation and monitoring measures

Data on localized climatic conditions need to be gathered at various points on the site through the introduction and use of small weather stations, measuring wind speed and direction, temperature, Aeolian-particulate material (dust), rainfall, relative

humidity, etc. These data should then be monitored and compared over time to recognize specific changes, trends and risks (Hurd, 2011, p. 1).

The site will be presented and interpreted to the public. Elevated walkways will lead the public through the site, clearly defining paths. To enhance this experience, a series of low-impact, reversible glazed 'boxes' will be inserted into roofless rooms and courtyards, providing exhibition spaces along with viewing ports, yet excluding the public from physical contact with the interior surfaces of the ruined structures. Use will also be made of restored buildings, which were reconstructed in the past (Al-Aidaros, 2009, pp. 97-100).

This work must be carried out within the framework of the World Heritage Convention's Operational Guidelines (World Heritage Centre, 2008), in order to maintain both the integrity of the site and the Outstanding Universal Value (OUV) for which it was inscribed under criteria iv, v, and vi. Therefore, all conservation work must safeguard the authenticity and integrity of the attributes that manifest the site's OUV (Cotte, 2011, pp. 1-3). The management plan produced for ADA is general to the oasis of Wadi Hanifah (Burro Happold, 2004), and not the specifics of the World Heritage Site (WHS). A conservation plan needs to be developed that details acceptable interventions for the WHS (Cotte, 2011, pp. 1).

Thus, conservation of the site is the core issue from which all other interventions must proceed. In an email written shortly after the conclusion of the workshop, one of the authors provided the following recommendations for conservation (Hurd, 2011, pp. 1-2):

- Put the conservation and preservation of the monuments as the first concern and root of the process from which the detailed planning of all other aspects of site development originate and spring.
- Recognize the importance of legibility of the interface between the historic remains and new conservation additions and reconstructions. A clear and discrete, but comprehensible, separation layer should be placed between historic remains and new additions. This could be a physical geotextile sheet (5), applied along the interface. Alternatively, the addition of a small proportion of glass microspheres, or even colored beads, in a mortar separation layer can be used, to clarify the interface.
- Value the 'sacred' dirt, containing microscopic data, pollen grains, seeds, animal hair, feces, etc. Samples have already been taken of all contexts, and these should be analyzed and contribute to the detailed archaeological record. This dirt will include wind-blown dust and debris, especially at floor level, fragments of paint and any polychrome decoration, soot and other evidential deposits.
- Appreciate and document the principal qualities of the historic architecture and archaeology by recognizing the subtle textural languages of the structures on site. During the workshop's inspection, at least four types of earthen construction were noted, and no less than four general styles



and textures of plaster finishes; these possibly represent and reflect the period at which a structure was first built. It is important to guard against the use of unified styles of plastering, color and texture. A unified pattern of color and texture will lead to a bland and monotonous appearance. Therefore, each wall, internal and external, of each structure should adopt a texture and color unique to the historic finishes observed in situ.

- Recognize the importance of allowing structures to lose moisture through capillary action and transpiration, especially at lower levels and through road and street surfaces.
- Consider with great care the texture, color and function of road and street surfaces throughout the site.
- Include a full design of road surfaces and dimensions to allow civil-defense vehicles ready access.
- Select appropriate shades of white paint, beyond bright titanium shades, to provide softer more broken shades.
- Reintroduce the technology for the production and application of local lime materials.

Further recommendations from another one of the authors were as follows (Jerome, 2011, pp. 1-2):

- Treat the site with great dignity. Enhance its spiritual qualities; link it to the role of al-Turath Charity Foundation, while permitting the site to provide a meaningful experience for visitors. The site has to be treated with respect because of its symbolism.
- Protect the view sheds. The site is prominently located on the escarpment. There is a sense of discovery while walking through the site, when views across the wadi are suddenly revealed. Development in these view sheds must be carefully controlled so as not to spoil the solemnity of the space, its evocative qualities, and the wonder it provokes. Similarly, views towards the site must also be preserved.
- Solve the technical issues of the new insertions. These appear to be delicate and reversible glass ‘boxes’, providing not only for interpretive panels, but also for safe viewing of the interior of the ruined spaces. Resolving the water removal issues will be critical to having the least impact on the ruins.
- Provide drainage for the interiors of roofless rooms. Rooms (and excavation pits) that lack roofs require special consideration for the evacuation of water. They have the potential to become ‘swimming pools’ during a sudden downpour. The base of a mud-brick wall is particularly vulnerable to standing water. Drainage can be accomplished by the introduction of infrastructure (requires archaeological excavation and breaching of original foundations), or by pitching the ground surfaces towards the center of the room and providing evaporative pans. Reburial of excavation pits and reestablishment of floor levels is recommended. Backfilling will assist with clarifying the archaeology, as well as providing proper interpretation of spaces, so that the excavated areas do not leave the visitor with a false impression.
- Establish an endowment for the continued maintenance of the site, but also of the new structures. All buildings require

sustained maintenance. For ruins, this is particularly important, because we are dealing with incomplete architecture that has lost its ability to shed water. For mud-brick ruins, this is even more critical, because of the ephemeral nature of the material that requires constant renewal of mud plaster, to act in a sacrificial capacity.

- Respect the materiality and textures of the site. Differentiate reconstructions from original material, and provide consolidation and engineering studies to assure the ability of existing remnants to support new construction. Provide horizon markers between old and new. This is critical for preserving the authenticity and integrity of the site.

3.2 Risk preparedness and disaster response

In 1994, technical studies were executed by ADA, including groundwater monitoring, water resource and flooding (Arriyadh Development Authority, 1994). There has also been an extensive recording of the site through laser-scanning (ATM3D, 2008) and photogrammetric documentation, as well as scaled drawings.

The management plan calls for a Site Management Unit that will be responsible for protection, maintenance and monitoring. The management plan also foresees a staff- and visitor-evacuation plan from fire and smoke, power-outages, and flooding (Kingdom of Saudi Arabia, 2009, pp. 54-55). In historic buildings, since the number of exits will be limited to the existing openings, this may constrain access in terms of carrying capacity at any given time. Staff will be trained to guide evacuation. An infrastructure of piped water has been installed to provide fire-fighting capacity, although it is recognized that in the event of a fire, the use of water could damage the mud-brick structures. Fire extinguishers will also be installed in each used building. In addition, infrastructure has been inserted to provide drainage.

A full risk-assessment survey must be undertaken and continually reviewed, leading to a disaster-preparedness-and-response policy with cooperation between the site authorities, civil defense, and perhaps, with the cooperation of groups within civil society. This assessment should continue to consider the safety of human visitors, but must also address the mitigation of risk to all aspects of the historic structures, including violent rain conditions that could also produce flooding; wind, including sandstorms; and other unexpected climatic activity.

The traditional architecture was designed to withstand the effects of floods by having tall stone foundations. However, the capacity of the recently installed plumbing infrastructure needs to be able to accommodate extreme events, including 100-year floods. In addition, provisional measures may be required, such as temporary backfilling in advance of the ‘rainy’ season, typically the spring and fall on the Arabian plateau. In general, backfilling of excavation soundings will both clarify presentation and prevent destruction by ponded water.

In terms of sandblasting as a result of sandstorms, the traditional protection for earthen structures involves periodic

renewal of renderings that act in a sacrificial capacity. However, as indicated earlier, care needs to be taken not to introduce a single type of mud plaster, because of the existing textural variety at the site, which provides interesting tonalities and aesthetic qualities. It may also be possible to provide vegetative ‘fences’ at strategic locations to act as windbreaks.

Additionally, risk assessment should investigate damage caused by local flora and fauna while recognizing and accommodating the need to protect and nurture endangered species.

4. CONCLUSION

Earthen-architectural ruins are among the most challenging types of archaeological sites to conserve. The very nature of the construction material makes it readily return to its original constituents, because there is so little alteration of the raw materials (soil, straw, water) during the production of mud bricks. Without the components that provide mud-brick construction with the capacity to shed water, ruins of this type are at great risk. In an urban context such as al-Turaif, this basic issue is exacerbated exponentially. Therefore, effective evacuation of water from interiors and exteriors of buildings is paramount, as is the use of shelter coats. In addition, caution should be taken in the choice of paving materials to permit evaporation, particularly near the base of walls.

Notes

(1) Mounir Bouchenaki, Director General of ICCROM; Zaki Aslan, manager of the ATHAR program at ICCROM; Michel Cotte, advisor to the ICOMOS World Heritage Panel; John Hurd, president of the ICOMOS Advisory Committee and president of the ICOMOS International Scientific Committee on Earthen Architectural Heritage (ISCEAH); and Pamela Jerome, officer of the ICOMOS Scientific Council and vice president of ISCEAH.  
(2) Prof. Ali al-Ghabban, vice president for Antiquities and Museums; Dr. Ali al-Moghannam, Site Manager of al-Turaif district of al-Dir’iyah; Mohammad al-Aidaroos, Antiquities and Museums consultant; and Bandar al-Malaq, architect.  
(3) Abdullah Arrukban, Program Manager, Arriyadh Development Authority.  
(4) The restoration of the Wadi Hanifah wetlands, designed by Moriyama & Tashima Planners Limited in joint venture with Buro Happold, won the Aga Khan Award for Architecture in 2010.  
(5) DuPont TYPAR range of textile perhaps TYPAR 32.

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