



**DIRECTORATE GENERAL OF ANTIQUITIES,
CULTURE, TOURISM & ANTIQUITIES DEPARTMENT
GOVERNMENT OF SINDH**
NATIONAL MUSEUM OF PAKISTAN MOULANA WAFAI ROAD, SADDAR KARACHI
dgantiquitiessindh@gmail.com

Karachi Dated the 27th February, 2017

Dear Ms. Director

In accordance with the Decision “**40COM 7B.44**” adopted at the 40th session of the World Heritage Committee held in 2016, in Istanbul, Turkey. I have pleasure to attach herewith the State of Conservation (SOC) Report on Historical Monuments at Makli Sindh (Pakistan) along with reports of Mr. Rand Eppich, Conservation Architect UNESCO Consultant, for the examination of the World Heritage Committee at its 41 session at Krakow, Poland, in 2017.

It is my sincere hope that these reports would fully address the Committee's specific requests and adequately inform the Committee on major achievements in the conservation of Historical Monuments at Makli Sindh (Pakistan) ---- A World Heritage Property as per guidelines of World Heritage Committee.

While thanking you for your continuous support, please accept, Madam Director, the assurances of my highest consideration.

(MANZOOR AHMED KANASRO)

DIRECTOR GENERAL OF ANTIQUITIES & ARCHAEOLOGY

To

Ms Mechtild Rossler
Director World Heritage Center
UNESCO, Paris

Copy for information and necessary action to:-

1. Secretary National History & Literary Heritage Division.
2. Assistant Secretary General to Pakistan National Commission for UNESCO.
3. PS to Chief Secretary Sindh.
4. Ms. Junhi Han Programme Specialist UNESCO South Asia.
5. Ms. Vibeke Jensen Director UNESCO Islamabad.
6. Mr. Kazi Ayaz Mahessar Provincial Coordinator Sindh UNESCO.
7. Director General of Archaeology and Museums Islamabad.
8. PS to Honorable Minister, Culture, Tourism & Antiquities Department Sindh.
9. PS to Secretary, Culture, Tourism & Antiquities Department, Government of Sindh.

(ABDUL FATAH SHAIKH)

DEPUTY DIRECTOR ARCHAEOLOGY

The original copy of the Master Plan consisting of 6 volumes is dispatched directly to WHC.

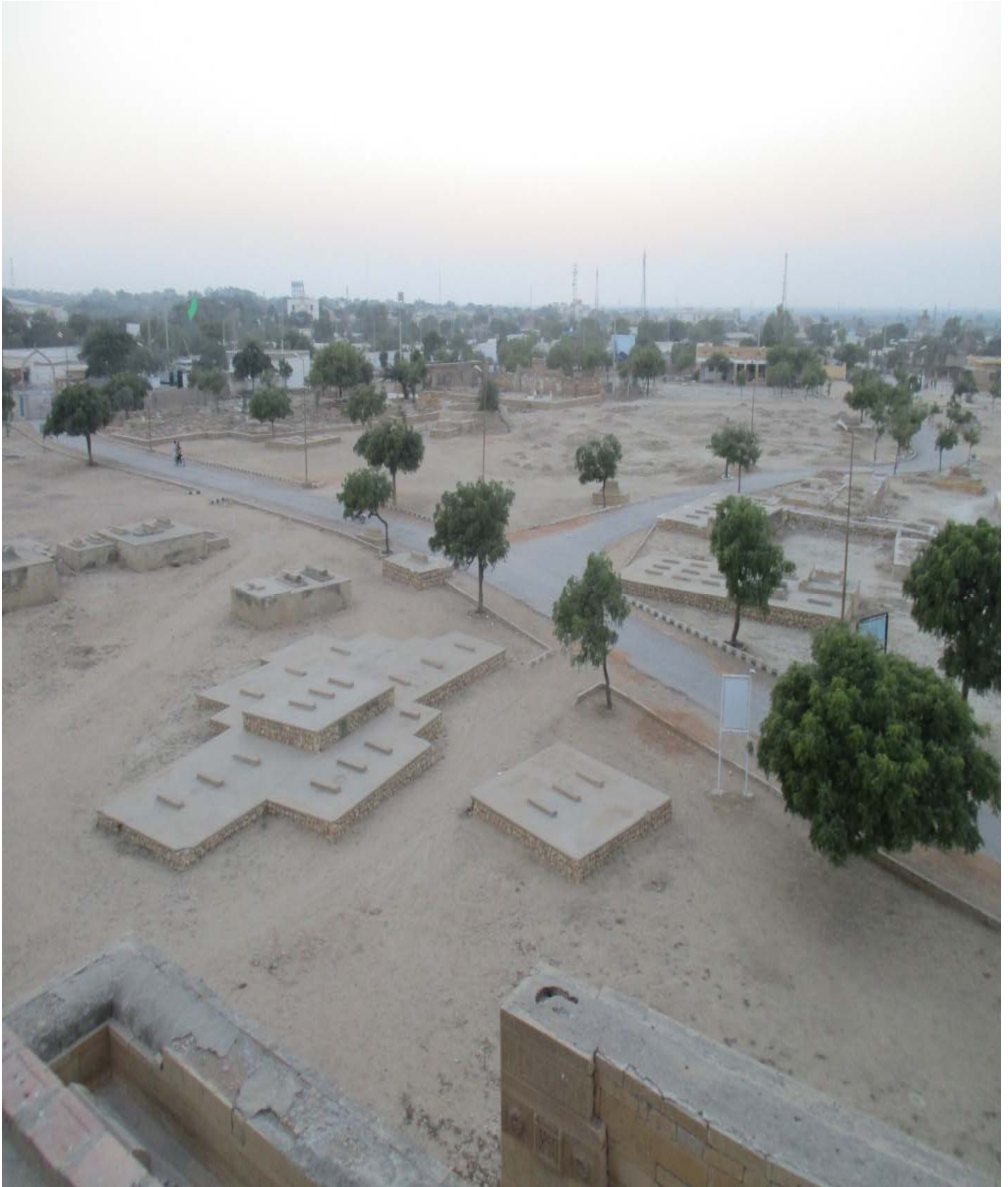


Office of The Directorate General of Antiquities & Archaeology
Culture, Tourism & Antiquities Department,
Government of Sindh (Pakistan)
National Museum of Pakistan, Opp: Sindh Secretariat, Karachi.

**UPDATED STATE OF CONSERVATION REPORT ON
HISTORICAL MONUMENTS AT MAKLI, THATTA SINDH
(PAKISTAN) (C 143) DECISION: 40COM 7B.44**

State party	Culture, Tourism & Antiquities Department Government of Sindh, Pakistan
Name of Property	Historical Monuments @ Makli
Criteria under which the property is inscribed (iii) of the World heritage Convention.	“Bears a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared”

Signature of Authority



Historical Monuments at Makli Thatta Sindh (Pakistan) – a World Heritage property

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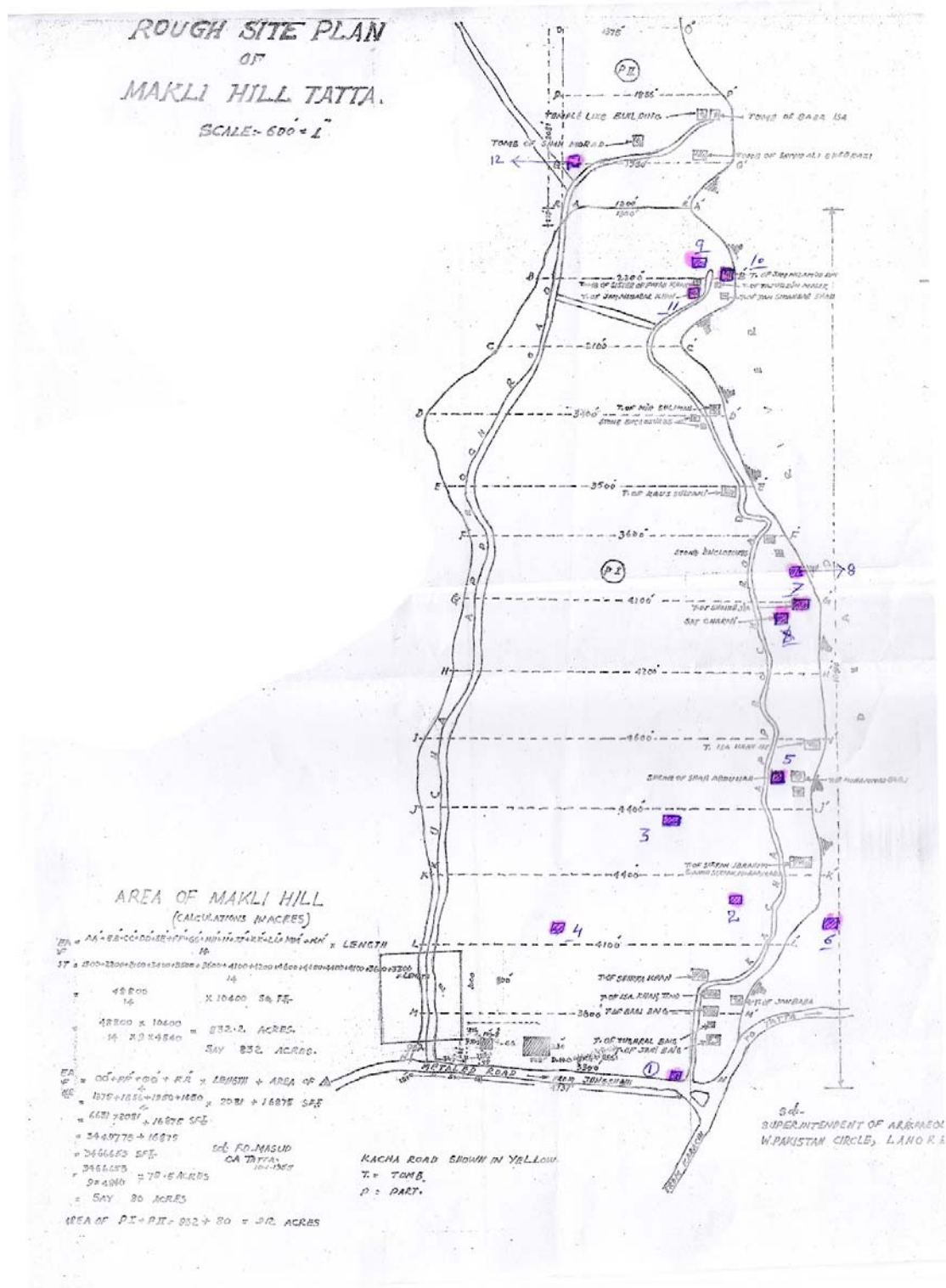
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EXECUTIVE SUMMARY

There have been great strides in improving the conservation at Makli Hills. These include proactive changes to address the short-term emergency needs as well as long-term plans for conservation and presentation:

- Management has been changed at the Ministerial and Directorate levels as well as at the site level. There is a new site manager and team at Makli. The site manager will begin living on site when renovations to the housing have been complete this month. This team is dedicated to protecting the Outstanding Universal Values of Makli and has proven so in their recent work on site.
- Reporting protocol has been established with frequent monitoring by the Director General of Antiquities & Archaeology, UNESCO representatives as well as by external international experts. Site reports are required daily while conservation works are ongoing and weekly with intensive activity. A follow up mission by the World Heritage Centre should be planned.
- Emergency stabilization and conservation work has progressed at eight tombs of significance and there have been many other smaller repairs.
- Cooperation has increased with the NGO Heritage Foundation Pakistan with meeting and an exchange of experience and documentation. Their work has continued at several sites and a liaison has been appointed to interface and coordinate between their activities and those of the site manager.
- Capacity building programs have begun on site as well as long-distance for key staff including the site manager. An on-site digital library has begun to raise capacity of the managers.
- Meetings have been held with those responsible for every active shrine on site to discuss conservation, visitation and issues.
- Detailed responses to every recommendation from the Reactive Monitoring Mission have been addressed with more detail in this report.
- Security on site has been improved with four traveling guards on motorcycles
- Documentation has been improved with the cleaning of the site offices and recovery of digital and paper records
- Weather stations, three, have been installed to monitor rain, wind, solar radiation, temperatures, etc.
- Crack monitors have been installed at all major monuments that are suffering from differential settlement. High accuracy vibrating wire crack monitors are being purchased for the more significant monuments.

MAP OF THE SITE



STATE OF CONSERVATION

The state of conservation of Makli is divided into two parts given its size and complexity. The first deals with the overall site and the second by individual monument. For the site the issues dealing with conservation are mainly encroachment, visitor management, access and presentation. For each individual monument the state of conservation is more serious with many requiring urgent attention. Each monument has been categorized in to three levels, emergency, urgent and non-urgent. Several factors were taken into account to create this categorization including, significance of the monument, structural condition, number of decorative elements, cluster and available resources. This section of the report is divided into site issues then a short section on each monument.

SITE – STATE OF CONSERVATION

The site over all is in poor to good condition. This is due to several factors including the sheer size of the site, its numerous monuments, foundation in an area prone to erosion and heavy daily use. The major threats that directly impact the site OUV and conservation are listed below with an explanation of the response following.

- Location on a bluff above an old branch of the River Indus. This has led to erosion due to uncontrolled drainage. This threatens individual monuments in various ways. The drainage is being studied and will be improved with additional documentation including topographic maps.
- Underlying geology. Some locations are unstable with differential settlement impacting groups and individual structures. The underlying geology is largely unknown and requires significant study. Boreholes have been planned around the site however the Group C which is more seriously impacted is the current priority.
- Numerous visitation and daily use. The site receives thousands of visitors per day with “surges” during holy days, Thursday evenings or during the full moon. Visitation is largely uncontrolled and is currently being addressed. There are 12 active shrines on the site with most inside structures that contribute to the OUV. Each “responsible” for the shrines has been met with multiple times about the need for conservation and communication. Traffic has been restricted.
- Encroachment of a small community living within the western boundary of the site as well as a small market, housing for a shrine at the eastern boundary of the site. The Department of Culture, Tourism & Antiquities is in discussions with District Administration for relocation of these communities.
- Presentation – given the heavy use there has been a rubbish problem and uncontrolled traffic. Rubbish bins have been installed at numerous locations including the active shrines and drives outlines with lime whitewashed rocks. Heavy undergrowth was also an issue and attracted local grazing animals. This has been removed and a maintenance schedule is being incorporated into the Provisional Master Plan.

INDIVIDUAL MONUMENTS – STATE OF CONSERVATION

Individual Monument

These are generally divided into three groups A, B and C. Only the more significant monuments are listed here as there are too many tombs to list in one report. However there is ongoing documentation and in the next State of Conservation Report every extant structure will be included.

Group A

Mirza Jani Baig Turkhan – STABLE: This monument is one of the most significant on site and the first dome seen when entering Makli. Works were carried out in the British Period as well as by the National authority in the mid to late 20th century. Its condition is good however there are suspected movements in the area around the dome so crack monitors have been installed.

Tomb 1 near Mirza Jani Baig – STABLE: This small tomb south of Mirza Jani Baig is stable but being monitored.

Mirza Jan Baba Tomb – GOOD: The condition of this tomb is very good. It has recently undergone conservation works by the Heritage Foundation sponsored by the German Government. The scaffolding has only recently been removed and walkway to the main road is still undergoing works.

Mirza Essa Khan Turkhan II Tomb– GOOD: The state of condition is good but given the significance of the tomb ongoing monitoring three times per week is being conducted. This tomb underwent extensive conservation in the late 20th century after a collapse and there are large amounts of heavy stone original material lying on the site. This has resulted in blocked drainage ports. This is being investigated as to what to do with the material and how to unblock the drainage. The gate is being locked nightly and crack monitors have been installed in the northwest corner. Temporary doors to the upper level have been installed for security purposes. Graffiti has been removed from the outer walls. The blocked drain ports are being investigated.

Baqi Baig Tomb– GOOD: There was conservation work carried out in the 1980s. However, there are extensive original decorative glazed tiles at the upper levels. This has been stabilized for emergency purposes and a longer term project planned. The compound is currently not secure as the openings are exposed. There are studies to close these openings to secure the compound. Graffiti has been removed from the outer walls.

Khwaja Abdul Latif– STABLE: This monument, although not significant, was at serious risk of collapse from the loss of brick at the base of the walls. The brick decoration was also loose at the top of the walls. Emergency stabilization works were conducted to shore up the wall

with bricks that matched in material, size and color with lime mortar and the decorative brick stabilized. While a smaller tomb it was important as it is visited often and near the entry.

Tugral Baig – GOOD: But the crack monitors have been installed and graffiti removed.

Ghairat Kahn / Firdous – GOOD: These monuments, although not significant, were at serious risk from collapse from the loss of brick at the base of the walls. The brick decoration was also loose at the top of the walls. Emergency stabilization works were conducted to shore up the wall with bricks that matched in material, size and color with lime mortar and the decorative brick stabilized. While a smaller tomb it was important as it is visited often and near the entry. Graffiti was also removed.

Ghairat Khan – GOOD: Works were carried out to stabilize the central tomb platform as it was suffering from erosion. Original stone materials were used in addition to new stone that matched the original. Lime mortar was used.

Compound North of Jani Baig – EMERGENCY: Works were carried out to stabilize the small brick arches and wall tops. While not a significant monument it was near the most visited monuments and at risk to the public if a collapse should occur.

Dewan e Shurfa Khan – STABLE: This significant monument is stable and there should be further in-depth investigations carried out. Since there were other emergency situations this was put on hold. The gate is now being locked to the main compound and crack monitors installed at the edges of the main dome.

Group B

Shaham Baig – STABLE: This is for future works as there are other more significant tombs in emergency state.

7 Stairs – GOOD: Conservation works were carried out here in the late 20th century.

SheikhJeio – GOOD: This active shrine is in good condition and is cared for on a daily basis as it is significant. However some paint materials used are not compatible. This was discussed with the caretaker of the shrine and a subject for future work.

Lali Masjid Tomb – EMERGENCY: This monument was at serious risk of collapse. There was a severe collapse in the late 1970s or early 1980s. This was unfortunate as it is a very significant and beautiful structure. Emergency works were carried out to stabilize the remaining portions of the main dome and three smaller side domes. This work included insertion of bricks of the same material at the base of the walls and shoring within the original arches. No original

materials were removed. In addition to protect the archaeological remains below a sacrificial low wall of 30cm was constructed above – this was carried out also to outline the original floor plan.

Group C

Jam Nizamudin–EMERGENCY: This is one of the most significant structures at Makli and its state of condition is severe. It is suffering from differential settlements and located on the edge of the bluffs. This condition has been a problem since the British Period and there were repairs in the late 19th century. Currently standard tell-tale crack monitors have been installed however this structure is so significant so more accurate vibrating wire crack monitors have been investigated and ordered. In addition, consulting soil engineers have been on site and have conducted bore holes to understanding the underlying geology.

Jam Mubarik – STABLE: More investigations must be conducted.

Mir Sulaiman – STABLE: Currently undergoing work by the Heritage Foundation.

Fateh Khan Bin Sultan Nizamudin Shah–STABLE: More investigations must be conducted.

Jami Masjid – EMERGENCY: This must undergo emergency stabilization as two arches are near collapse. There was propping in the mid-20th century on the west wall but this is insufficient. The soil is currently being investigated and this structure will be addressed soon.

INTRODUCTION

The historical monuments at Makli Thatta a historical/cultural site are situated some 55 miles south-east of Karachi at the apex of the delta of the Indus and within 3 miles of its right or western bank, are spread over an area of 9 Sq. K.M. (912 acres). It is replete with history of more than 400 glorious years of its rulers from 14th to 18th century A.D. The Half a million tombs and graves make it the greatest necropolis in the world. This unique assemblage of massive structures presents an impressive order of monumental buildings in the different architectural styles. It is an example of outstanding universal value for its achievements in architectural designs and building art. The site was inscribed on the World Heritage sites list during the 5th session of the World Heritage Committee in 1981 under criteria (iii) of UNESCO World Heritage Convention. Historical Monuments at Makli — a World Heritage site was transferred from the Federal Government to the Province of Sindh in 2010 but no funds were given to the province for the protection, conservation and preservation of Makli by Federal Government. The decision to monitor the state of conservation of the Makli site was already taken up by World Heritage Center in 2005 by showing serious concerns about its state. Since long no work was done for the preservation and conservation of Makli site by the Federal Government. This is despite the fact that stringent warnings had been issued to the then custodians — Federal Archaeology Department for its protection and conservation but of no avail. Taking over the World Heritage Site and working on it in conformity with guidelines suggested by World Heritage Committee was a daunting challenge amidst many to follow such as; capacity building of technical staff, devising the strategy for taking the required funds from Government and compensate for the damage was done for lack of preservation of Makli site by Federal Archaeology Department. The Sindh Culture, Tourism &

Antiquities Department, Government of Sindh is fully determined to follow the guidelines suggested by WHC for preservation, protection and conservation of the property. We are well-aware about our duties, responsibilities and the theme and mode of work according to the standard and the prevalent-set codes of preservation. Given our own checkered history of the conservation of Archaeological Heritage in Pakistan, the Government of Sindh would do well to support culture that is imperative to the promotion of tolerance and plurality in any society. The reminder that nation stays alive when its culture stays alive should not be lost amid other priorities — is our unflinching commitment towards the protection of Heritage of Sindh, particularly World Heritage Properties.

Here it remains to be added that in the past few years the Culture, Tourism & Antiquities Department established a practice of working on documentation and monitoring needs of sites as an integral part of the project and conservation process. The whole process and the data generated from it inform the next levels of each project, thus; fulfilling the major guidelines mentioned in many forums.

Next to above, this report will discuss a range of case studies and will demonstrate how documentation, conservation and monitoring of the built heritage have augmented the various conservation initiatives on a variety of building types.

RESPONSE TO WORLD HERITAGE COMMITTEE DECISION 40 COM 7B.44

Concerns / Decisions of WHC	Response from Culture, Tourism & Antiquities Department Government of Sindh
(1) It expressed its deep concern about deteriorated state of conservation of the property noting that encroachment, vandalism and deteriorated monuments are affecting its integrity and pose significant threats to its outstanding universal value (OUV).	(1) Serious steps have been taken with regard to removal of encroachments existing for last 20 years on the world property as per guidelines of World Heritage Committee. The Revenue Department at Makli has surveyed and numbered total encroachments which are 269 houses and shops in the Magsi and Sheedi Villages falling within the jurisdiction of World Heritage property. The Revenue Department on the advice of the Culture, Tourism & Antiquities Department has granted the land measuring about 15 acres for the people occupying such property, who will be shifted to the said land shortly.
(2) It strongly urges the state party to address the pressing issues of site management and monument conservation at the property so as to fully implement these	(2) The Culture, Tourism & Antiquities Department is fully aware of the responsibilities for protection and preservation of the World Heritage

<p>recommendation as matter of urgency such as ;</p>	<p>property. Moreover, in order to promote the cultural-based activities at possible forum so as to ensure protection and to chalk out proper strategy, the constant and regular seminars, symposiums and workshops are being held under the umbrella of Culture, Tourism & Antiquities Department. For this purpose, the Department is fully equipped with the skilled archaeologists and conservationists.</p>
<p>(a) To establish regular trash removal system and remove graffiti.</p>	<p>(a) Trash bins have been put in place. A janitorial team for each of the 4 zones is working to manage the removal of vegetation as well as removal of trash from the trash bins. At various monuments, there have once been a lot of graffiti found which have already been removed from the protected monuments, ancient mosques, tombs, structures, remains and etc. Besides this, a regular team as stated above has been waging the campaign to ensure removal of such graffiti. Not only this; with the collaboration of the concerned district</p>

	<p>administration and department, the regular sanitation and removing of wild growth from the protected premises of Makli Thatta is carried out. It is pertinent to mention that 100% monument graffiti has been removed.</p>
<p>(b) To establish regular inspections of the property including overnight in order to prevent inappropriate uses unsanctioned vehicular access to report and record on activities on site.</p>	<p>(b) The motorbikes and mobile phones have been provided for round the clock security of the site for its better protection. The main entrances to the site have been staffed for the blockage for entry of heavy vehicles. The state party is mulling other options for blocking the entry of small vehicles also by giving them an alternate access. In order to curb the menace of illegal access and entry of vehicles within the premises of cultural and protected premises; the Watch & Ward Staff is deputed round the clock at the main entrance of Makli Hill Monuments, Thatta. Additionally, the Curator, Makli Hill Monuments pays frequent visits in late hours for the sake of checking activities at the main entrance.</p>

<p>(c) To complete remaining stretch of barrier wall marking the boundaries of world Heritage property.</p>	<p>(c) The State party has started the work of barrier wall and the same will be completed by the end of 2017. In the recent past, the Department tried to provide barbed wire fencing/ boundary wall, but due to the ownership issues, the target could not be achieved in time. The relevant assignment is hoped to be accomplished within the time frame as mentioned above. We are cognizant of the holistic view of heritage, and the integrated ways in which communities perceive and experience it does not allow for the boundaries around ‘World Heritage’ to be drawn as neatly as our home. This issue is primarily acknowledged by the Department, which solicits input regarding the need for erecting boundaries around the World Heritage Site.</p>
<p>(3) It also requests the state party to:</p> <p>(a) Install as matter of urgency at least 3 weather stations within the property.</p>	<p>(3) (a) Three weather stations have been installed on the locations as recommended by WHC, which would inevitably be beneficial to gauge the weather effects so as to adopt precautionary measures for the</p>

	protection of World Heritage site/ remains for their documentation and preservation purpose.
(b) Install crack monitors on the cracks that cause structural concerns in the principal monuments.	(b) The crack monitors have been installed on most of the fragile monuments such as Mirza Jani Baig's Tomb, Mirza Tughral Baig Tomb, and Tomb of Jam Nizamuddin and remaining work will be done shortly. There are a lot of principal monuments at the necropolis of Makli, Thatta. For the purpose of ascertaining the current and future structural concerns thereof, the crack monitors are being considered best recommended by the conservationists so as to know the exact nature of movement and its scope damaging the monuments with a view to their better monitoring for better preservation. It is not necessary to monitor each feature or every intervention. Therefore, as a first step in elaborating the monitoring methodology, it was critical to know which different building features and intervention types needed monitoring. The whole

	<p>area of Makli necropolis is compiled by listing these features such as inherited building anomalies, permanent building features, short-term intervention methods to support conservation, and long-term intervention methods. Such features are compiled into a matrix and paired with the appropriate tools and procedures that range from simple gypsum crack monitors and digital photography.</p>
<p>(c) Undertake soil investigations or geo physical survey on surroundings of mausoleum of Jam Nizamuddin on basis which intervention should be elaborated, also using data from crack monitors.</p>	<p>(c) The soil investigation, documentation and damage assessment of the tomb of Jam Nizamuddin was carried out by the Heritage Foundation with the support by UNESCO. Further actions for the soil investigations are in process which will be compared with the earlier study and will be discussed with the structural archaeologists on the basis of which appropriate stabilization measures will be taken. The crack monitors have been installed for consistent monitoring.</p>

<p>(d-1) State party should develop detailed condition mapping and documentation on each monument.</p>	<p>(d-1) The State party is following this principle of conservation strictly in conformity with the guidelines of WHC before the conservation work is done on site. Yes, the documentation prior to any conservation and restoration works is considered as a basic pre-requisite for understanding the historic building or site. It is a process which continues during the conservation of any monument and is the only accurate tool for recording information in order to understand the structure, ultimately leading to the better management of cultural heritage with a view to its better preservation. The Department is cognizant of developing detailed documentation, mapping and structural survey reports supported by relevant backgrounds of the monuments of Makli necropolis so as to provide exhaustive information to the readers, scholars, students, teachers, archaeologists, engineers and other stakeholders about the history of conservation. Recording</p>
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	<p>and mapping the existing conditions of a heritage site is an important process in knowing the gamut of any damage causes and ultimately be useful in proposing an intervention as part of conservation. A glossary of various conditions is created and updated based on the site conditions and past surveys done by building conservation team.</p>
<p>(d-ii) A characterization of original building fabric (e.g. stone & brick masonry, mortar, plaster, tile and glaze)</p>	<p>(d-ii) This principle is followed as per provisions in the Master Plan of Makli site. In the past, the same principles had been exercised by the Department in order to ensure genuineness and ground reality of the Monuments located at Makli necropolis while chalking out such Master Plan for Makli. For this purpose, it is highly and strictly observed to protect the characteristics of the monuments i.e. stone, brick masonry, glazed tiles and artworks of ancient times.</p>
<p>(d-iii) A history of inventions to understand series of subsequent work on each building how these may affect</p>	<p>(d-iii) This principle of conservation is followed very strictly as per provisions of Master Plan of Makli site. In addition to promoting the</p>

<p>the development of successful interventions.</p>	<p>cultural value of these buildings and encouraging appropriate policies and strategies for conservation, the Culture, Tourism & Antiquities Department intends to establish a bond amongst the senior conservationists& archaeologists working at different forums on these lines for want of successful development and interventions. Demand for heritage conservation in Sindh is growing at an increasing rate and there is very little local supply capacity. However, there is considerable potential for the services. But for the Cultural Industry to remain competitive over this timeframe it must continuously innovate. This will include broadening the approach to heritage conservation to embrace more fully the cultural context of living heritage including intangible cultural heritage.</p>
<p>(d-iv) A monitoring and maintenance plan to be implemented once the interventions are complete.</p>	<p>(d-iv) This principle of conservation is followed very strictly as per provisions of Master Plan of Makli site. The Department provides a unique model for managing</p>

	<p>heritage at the local level and has established an integrated approach to conserving heritage buildings and revitalizing public streetscapes. Innovative plans have been devised by the Departmental strategic committee with the cooperative efforts between local government and the community, resulting in a renewed sense of pride in the heritage. Heritage and the Heritage awareness programs have played a significant role in the economy of District Thatta Makli Hill. The tourism experience and the sense of the place have been enhanced. Tourism numbers have increased over recent years. The last visitors' census showed that more people have visited Makli necropolis.</p>
<p>(e) Establish procedure to document the fallen original fabric and store it carefully in appropriate store houses. This procedure should include following steps.</p> <p>(i) Photograph the materials as</p>	<p>(e) Every attempt is being made to document fallen original fabric and stored very carefully.</p> <p>(i) Materials in situ are</p>

found in situ.	photographed.
(ii) Label and photograph individual elements	(ii) This principle is being followed strictly as per guidelines of WHC.
(iii) Store the materials in a dedicated storehouse/magazine.	(iii) All lying materials on the site have been stored in a proper storehouse.
(iv) Create and maintain an inventory of all collected items.	(iv) The inventory of all collected items which were lying is being maintained.
(f) Document as a matter of emergency, the existing architectural surface decoration such as the remaining glazed tiles—which constitute an important part of the attributes of OUV, yet are for the most parts already lost and establish a condition report to be accompanied of damage assessment.	(f) This principle of conservation is followed strictly while doing the conservation work on the site as per guidelines of WHC.
(g) Resume the conservation work at Sultan Ibrahim mausoleum taking in to the	(g) The conservation work at Sultan Ibrahim mausoleum is in progress as per guidelines of WHC.

account its critical state both as structural and surface level especially in regard to the domes and architectural surface decoration.	
(h)Immediately establish Management plan including systematic monitoring system and plan for capacity building of the staff of the Government of Sindh's Directorate for Archaeology without waiting for finalization of Master plan.	(h) The management plan is under preparation and its elements are already being followed and implemented at the site. The department will submit to the WHC the management plan upon its completion.
Finally it urges the state party to finalize the Master Plan for property and submit it to the World Heritage Center by 1st February, 2017 for review by the Advisory bodies.	Master Plan of Makli site—a World Heritage property has been prepared and is being submitted with this report to the World Heritage Committee for review.

UPDATED STATE OF CONSERVATION WORK IN PHOTOGRAPHS

To establish regular trash removal system and remove graffiti



Trash bins have been installed as well as meetings held with those responsible for the shrines. The site has also been cleaned to discourage litter.

COMPOUND NEAR BUKHARI SHRINE

Before



After



The vegetation near the compound of Bukhari Shrine has been removed.

Removing of Graffiti

Following is the pictorial account of the graffiti removal from the site.

Removing of graffiti on Essa khan Turkhan ii Tomb

BEFORE



AFTER



BAQI BAIG

BAQI BAIG TOMB

Before Graffiti



After Graffiti



TUGRAL BAIG

Graffiti Removal

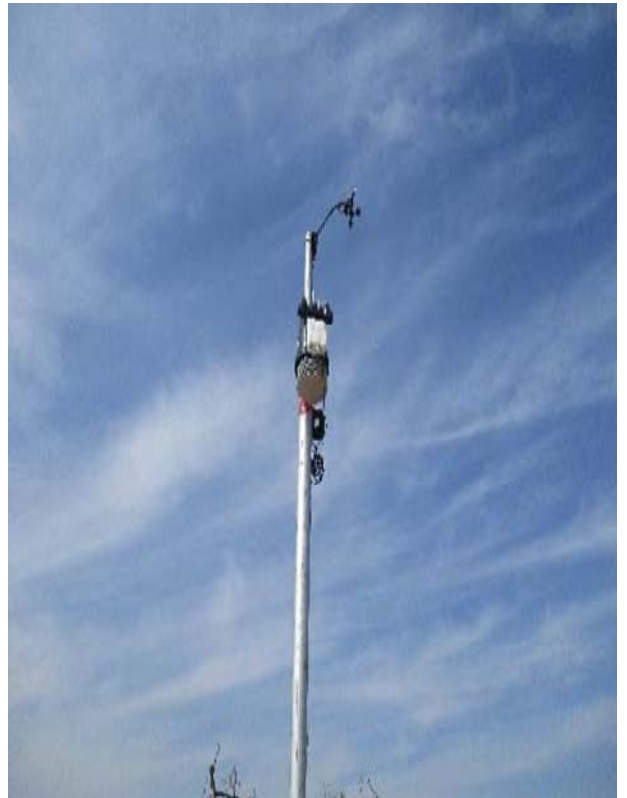
BEFORE



AFTER



WEATHER STATION INSTALLATION



INSTALLATION OF CRACK MONITORS ON JAM NIZAMUDDIN



In addition, vibrating wire crack monitors with data-loggers have been ordered which will measure the movement of the building to 0.01mm. This will allow monitoring during any intervention or subsoil investigation.

INSTALLATION OF CRACK MONITORS



ORIGINAL MATERIAL IN DEDICATED STORAGE

Before



During



After



KHWAJA ABDUL LATIF

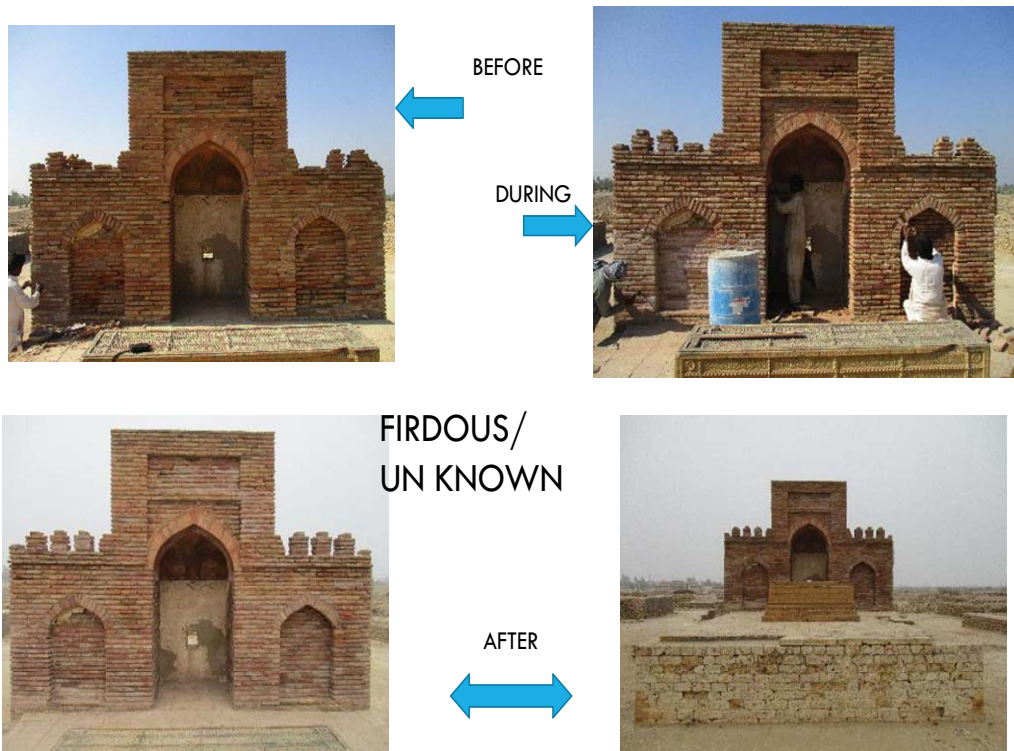
Before



After



GHAI RAT KHAN



BAQI BAIG TOMB

Before



After



UNKNOWN MONUMENT NEAR DEWAN E SHURFA

BEFORE



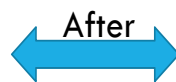
AFTER



UNKNOWN / MERAN BAI TOMB



UN KNOWN/
Meran bai tomb



LALI MASJID TOMB

Before



After



Before



After



JAMI MASJID MAIMAKLI

Before



After



COMPOUND NORTH OF JANI BAIG



After

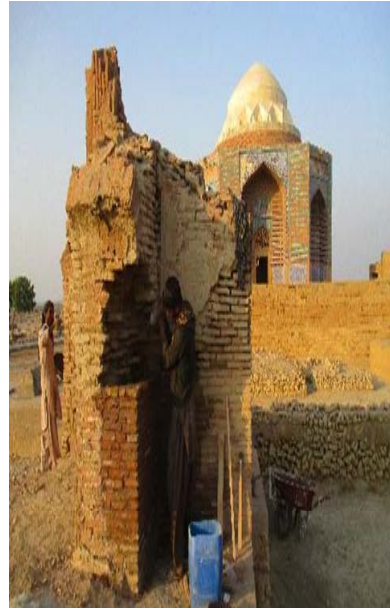


MONUMENT SOUTH OF JANI BAIG

BEFORE



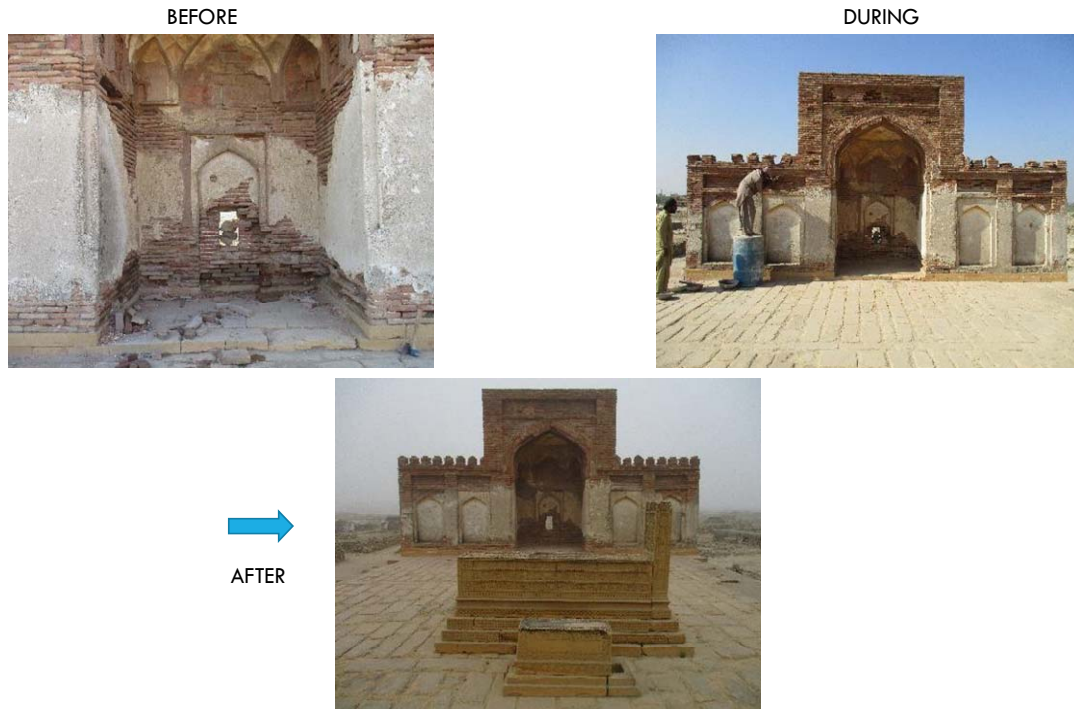
DURING



AFTER



KHWAJI ABDUL LATIF



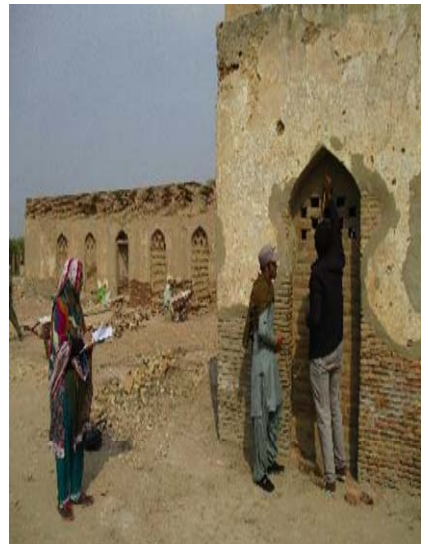
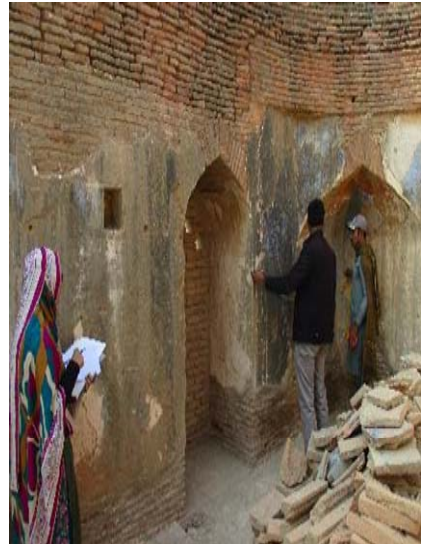
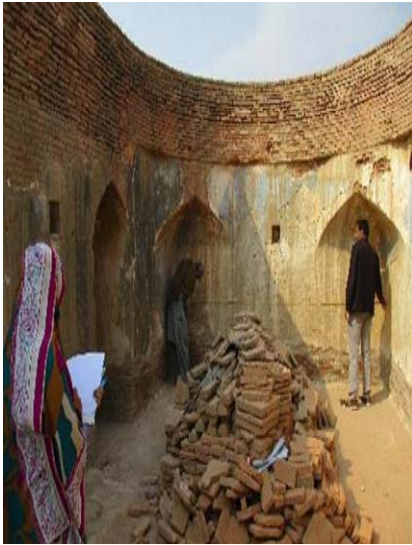
GEOPHYSICAL INVESTIGATIONS AT JAM NIZAMUDIN



SECURITY PATROL



SURVEY AND DOCUMENTATION



STORING AND ANALYSIS OF HEAD STONES

<p>Stone 1</p> 	<p> موالکریم / یاغفور / یاغفار فبشره بمغفرت واجر کریم / فاللہ خیر حافظا و موارحمہ الراحمین / مہیمنا بہ نبی و علی و مردو پسر ---- / محمد کریم ابن حاجی علی اصغر اصفہانے / بمہ ماہ محرم محم ---- / باہی جوارشین / سنہ ۱۱۵۵ ہجری </p>
<p>Stone 2</p>	<p> بسم اللہ الرحمن الرحیم بتاریخ وفات مرحوم مبرور اقا ابراہیم مشہدی ولد مرحمتہ مابند علی خراسبونی فی یوم --- // فی شہرے ذالحج بسنة سبع و ستین بعد الف سنہ ۱۱۶۷ </p>



GENERAL VIEWS OF THE SITE (BEFORE CLEANING)





GENERAL VIEW OF THE SITE (AFTER CLEANING)





CONCLUSIONS – NEXT STEPS

A lot has been accomplished at Makli – but the staff and management know there is still much to be done. This is only the beginning. In order to protect the Outstanding Universal Values of Makli a continuous effort must be made. Those dedicated to protecting Makli know they are not only doing this for the material fabric but for the communities of Thatta and larger community of Sindh.

These next steps include:

SHORT TERM

- In-depth investigations at Jam Nizamuddin including the geological subsurface, digital vibrating wire crack monitors and daily inspections. This will include investigations into companies and experts that could perform an intervention on the foundation. Including micro piles, slope stabilization, erosion control, etc.
- Complete emergency stabilization currently on-going.

- Follow up with the WHC on its comments on the submitted Master Plan.
- Visitor management and collection of numbers of visitors.
- Continue to build the site documentation center. Add volumes on the history of the site, historic photographs but also conservation documentation and training materials. This includes scanning the existing historic photographs on site and also those in the archives in Karachi.

MEDIUM TERM

- Develop an on-site conservation lab to test new materials, existing historic materials. This also includes the addition of tools to perform complex interventions such as injection grouting behind historic plaster.
- Capacity building in various aspects including site management, conservation theory, materials and material testing. This will be conducted out on site (following a successful session in January) as well as distance learning and search for opportunities outside Sindh including ICCROM.
- Improve visitor management and include statistics of visitors. This includes the installation of a visitor information system.
- Continue to improve security with the installation of security cameras on site at the known problem areas with graffiti.

LONG TERM

- Remove the existing water tower and other government buildings that were added in the 1970s and 1980s. This would greatly improve the presentation of the site but is not a conservation priority.
- Create a site wide Geographic Information System. This would greatly help management and observation of the site.
- Hold a conservation congress on site to discuss the challenges and opportunities with conservationists in South Asia. This would invite experts from around the region. Scholars from Sindh, across the region and international experts to debate the history, conservation and future of Makli.

Evaluation and Verification of ongoing work at the World Heritage Property of the Historical Monuments at Makli, Thatta Sindh (Pakistan)

January 30, 2017



*Culture, Tourism & Antiquities Department,
Government of Sindh (Pakistan)*



This Report has been prepared by Rand Eppich, Conservation Architect, UNESCO consultant

*It is funded by the Government of Sindh,
Culture, Tourism & Antiquities Department*

Figure 1 -Front cover, mausoleum of Jam Nizamuddin, Group C, Interior view of the uncompleted dome.

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Keywords: Sindh, necropolis of Makli, Pakistan, Management Plan, Jam Nizamuddin, Thatta

Project Team:

Serfraz Nawaz Jatoi (Archeological Conservator)

Irshad Ali Rid (Curator)

Aamir Ahmed Memon (Assistant Curator)

Khursheed Ahmed (Chemist)

Zafar Iqbal Warraich (Civil Engineer)

Ashraf Palijo (Draughtsman)

In collaboration with

Kazi Ayaz Mahessar, UNESCO Provincial Coordinator, Sindh, UNESCO Islamabad, Pakistan

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Thank you

The team who prepared this Evaluation and Verification Report wishes to thank Kazi Ayaz Mahessar, from the UNESCO Karachi office as well as the numerous individuals from the World Heritage Centre and ICOMOS that visited the site and offered their advice over the last several years, including the Reactive Monitoring Missions including the most recent dated April, 2016 by J. Han and J. Bell from UNESCO and ICOMOS respectively. This advice provided fertile ground for real improvements on site in both conservation and management.

But most importantly the team wish to thank their managers, directors and others who have rapidly improved management, provided necessary resources for urgent conservation measures and also inspired for this work. This includes the Minister of Culture, Tourism & Antiquities, the honorable, Sardar Ali Shah; the Secretary Culture, Tourism & Antiquities Department, Mr. Ghulam Akbar Laghari and Director General Manzoor Kanasro of the Antiquities Department.



*Figure 2 - Crack monitors were installed at four corners on the roof of the Mirza Jaani Beg Tur Khan Tomb
In order to measure any future movement of the structure*

FOREWORD

Makli is a unique place, an ancient necropolis yet full of life. This extensive site situated along 6 kilometers of bluff above the old course of the Indus River covers over 1,000 acres with 64 major mausoleums and large tombs, 9 canopies, between 500,000 to 1 million graves and 43 extant domes. It contains the remains of local and prominent families, spiritual leaders and dynasty rulers spanning approximately from the XIV to century to the present day.

Makli is visited daily by the thousands - surrounding communities pray at the 12 active shrines contained within its boundaries, cherish family tombs and gather together to escape the busy city. This makes the site a dynamic living place of veneration, assembly and recreation. Continued access to the site must be encouraged yet carefully managed as to minimize impact on the fragile monuments.

This considerable site is maintained by a newly appointed team of 27 managed by one full-time archaeological conservator with a part-time staff of professionals – an objects conservator, architect, chemist and civil engineer. Needless to state they are busy as the site is facing a number of very serious threats. These threats range from decades of insufficient maintenance and lack of conservation before 2012, heavy visitation, unstable geology, poor drainage, inadequate original building materials, encroaching settlements, wind borne salt and sand and other environmental factors. UNESCO's World Heritage Centre, the World Heritage Committee as well as local and international conservation professionals have all been deeply concerned for the state of conservation at this special place. There have been numerous inspections, reports, urgings and a Reactive Monitoring Mission in April, 2016, that suggested the site could be placed on the List of World Heritage in Danger. This recent mission outlined very specific recommendations which are currently being addressed by the new on-site team with the full support of the Culture, Tourism & Antiquities Department of the Government of Sindh. This team is working diligently to address these issues.

This report describes their work in two parts: Evaluation and Verification responding directly, point-by-point to international concerns and the recent reactive mission report and Key Recommendations for issues not earlier addressed in depth. The Evaluation and Verification will be summarized in one page in the following Executive Summary with an additional page for Key Recommendations. The body of the report will go into more depth with extended descriptions, shortcomings and photographs. Following each section in the evaluation is a short paragraph entitled follow-up that addresses the remaining gaps necessary to complete the tasks at hand.

There has been much written about Makli, its history and its monuments. This information is readily available elsewhere and is listed in a growing bibliography being created for the site. It does not serve our purpose to repeat this information within this report as this is not the focus. The focus here is to address concerns, update the Department of Antiquities, the local and international conservation communities and provide thoughts and ideas for improvement. Finally, it must be noted that this is a working document and will be updated as work progresses on at Makli or should there be additional questions or concerns. A revised document will be created by May of 2017.

EXECUTIVE SUMMARY

Evaluation and Verification

Management:

1. A provisional management plan is in progress. This is a short term plan is intended to supplement the larger already in progress Master Plan. Systematic monitoring began in the fall of 2016 and continued in January 2017 with a calendar of monthly visits to each monument. This plan will be available shortly. Capacity building sessions were conducted in January 2017 including management, documentation, condition assessment, monitoring, and materials. This is described in this report but in greater detail in a separate report. Additional training opportunities are actively being sought as well as materials being sent to the on-site manager.
2. Security has been improved at the site. The government purchased 4 new motorcycles to be maintained on site in order to make regular rounds. The main office and residence for the archaeological conservator and security has been renovated including a fresh water pipe and tanks to accommodate 24 hour on site living. This is the first time possible since 2001. The main gate to the south has been closed and vehicular access reduced to the gate *at the residence*. There is still vehicular site access to the community located on site at the western boundary.
3. The barrier wall is not complete because blocking the access of the community living within the site must follow strict protocol and inter-ministry cooperation. However, the foundation does extends and raw material were delivered. Once this community has been respectfully relocated the construction of the barrier wall will continue with a minor boundary modification submitted to the World Heritage Centre.
4. A new area has been established for new burials along the western boundary. Community leaders were met, Illegal burials have largely been halted.
5. Trash removal has been initialized. The site was cleared of rubbish and vegetation throughout the more accessible areas although work remains in the more remote locations. This is an ongoing challenge given heavy use of the site. Waste bins have been installed throughout with surplus bins awaiting deployment after observation. A small truck was purchased for trash removal and one staff member is dedicated to making rounds daily. During evaluation in January 2017, three impromptu meetings were held at active shrines to discourage litter.

Conservation:

6. Three weather stations were installed at each cluster to collect wind, temperature, rainfall. Although the data loggers must still be installed along with additional training.
7. 15 crack monitors have been installed at 5 monuments. Interns have been trained to regularly observe these crack monitors. Avongard tell-tales at Jam Nizzamuddin are not sufficient given the active movement and significance of the monument. Vibrating wire crack monitors were investigated and RST Instruments was contacted. ANY intervention to halt the movement or stabilization of the slope must be more accurately monitored that possible with Avongard.
8. A geotechnical survey is currently underway and a borehole has been excavated to the north of Jam Nizzamuddin. The results are forthcoming.
9. Stabilization efforts are underway at 6 structures including Lali Mosque. The situation at Jam Nizamuddin and Jamia Masjid are much more delicate and must be studied in-depth before interventions. Documentation including survey measurements and limited condition assessments at the 6 work sites has been conducted however these require improvement.
10. Fallen original fabric has been documented and stored in a limited way. A procedure and training session was held in January. However there still exists original fabric stored in some monuments.
11. Documentation is being conducted and is underway including existing architectural surfaces and glazed tile. This work is not of an urgent nature given the emergency state of other monuments.
12. Work on the Sultan Ibrahim Mausoleum has resumed *abet slowly*. This work is being conducted by the Heritage Foundation and outside the full control of the Department of Antiquities.

Key recommendations

This second section of the report outlines in detail the following recommendations building upon the previous reports, observed immediate threats to the OUV observed on site and the short term needs discussed with the new site manager. In brief:

- 1) Retain and support existing management/conservation team. They have made a good start and must be encouraged to complete the job they have begun. They now know the site, its monuments, the individuals responsible for each of the 12 active shrines and the community leaders. They are in the best position to continue the work detailed in this report.
- 2) Geotechnical investigations must be complete in the area surrounding Jam Nizzamuddin. Install highly accurate vibrating wire digital crack monitors before any drilling for samples or ANY intervention. Monitor closely these instruments for any significant movement. Seal all cracks in the base surrounding the mausoleum to prevent further water infiltration and control all drainage on site around the structure. Consult foundation engineers for designs to stabilize the structure including research into qualified companies in Pakistan that could sensitively install micro pile or other solutions to the differential settlement.
- 3) Conservation Laboratory - create an on-site material testing lab. Test for any salts within new materials such as sand, lime mortar, water and brick. This testing lab should also be able to perform analysis of historic materials such as quality of lime and compatibility with new materials. Equipment could be collected that include microscopes, scale, furnace, water filtration system, vacuum, and lab ware.
- 4) Documentation Centre – improve and store documentation on site. This includes adding to the library key texts and guidelines concerning conservation and management as well as specific information regarding Makli. *Obtain all information in a digital form from Heritage Foundation including site plan(s), condition assessments of individual monuments and all relevant information.* Purchase a scanner to digitize all historic photographs. This should eventually lead to the creation of a Geographic Information System (GIS) to assist in site management.
- 5) Visitor Management – begin an education programme for all visitors as to respect to reduce rubbish and graffiti. Investigate methods for counting to create statistics of the number of visitors including IR sensors. Continue to control visitor vehicles by further defining paths and roadways. Install low cost security cameras at key points that have with graffiti and rubbish.
- 6) Capacity Building – Continue building knowledge and capacity with further professional education programmes. This includes on-site, distance learning, and sending key staff to international training sessions. This includes ICCROM, UNESCO and other opportunities. A list is currently being developed including distance learning and the creation of an on-site library. Continue to develop and refine the guidelines for conservation. These guidelines should include illustrated examples clearly understood by managers, inspectors and craftsmen.
- 7) Search for funding sources including visitor contributions, UNESCO sources and other foundations. Such funds could be used for specific conservation projects, site management and capacity building.

EVALUATION AND VERIFICATION

1. Management Plan

In 2013 a Master Plan for Makli was begun which included extensive mapping and documentation, large infrastructure improvements, tourist amenities such as toilets, a visitor center, rest areas and walking routes. This Master Plan, importantly, also included conservation. However, this ambitious plan has taken substantial time given its long term scope and complexity. Therefore a short provisional management plan is being drafted. This is a direct result of the daily needs of the site the urgent state of condition of many of the monuments and upon the advice of UNESCO. This provisional plan is not intended to replace the Master Plan but to fill in the short term gap and become a true working document – hence the inclusion of provisional in the title. Both plans are intended to work together and must contribute to the conservation of this important site. The provisional management plan follows the basics and guidelines from the classic publication from ICCROM, UNESCO and ICOMOS: *Management Guidelines for World Cultural Heritage Sites* by Bernard Feilden and Jukka Jokilehto (the exception of community involvement and background research given a lack of time and urgency). This guide was chosen as the format for this plan as it is well respected, easy to understand and readily available. This publication was discussed on site during meetings in January during working sessions on the provisional plan.

In order to create a provisional plan the team met virtually and communicated on-line for several weeks in late 2016 before an on-site session during January, 2017. During these weeks the site was inspected and management issues and priorities discussed. It was made clear that this a management plan is to be an instrument to aid in identifying priorities, making decisions and justifying expenditures. While the team sought to enlarge and discuss the issues with other international experts and operating non-profits such as the Heritage Foundation, unfortunately, a lack of time did not permit this. It is the desire of the team to be inclusive and consider the opinion of others that care for this special place, therefore the team invites input at any time. This provisional management plan is currently being drafted and will be available in March of 2017.

One key aspect of the plan was identifying the living nature of the site, a topic largely omitted from previous plans. During these sessions a map and list was made of all the active shrines within the borders of the site. This was extremely useful as each shrine, given its religious nature, is managed by a separate party. These were all visited at the end of 2016 and again in January, 2017. Each has its different issues as some are located within significant monuments while others are adjacent or within non-significant or non-contributing structures.

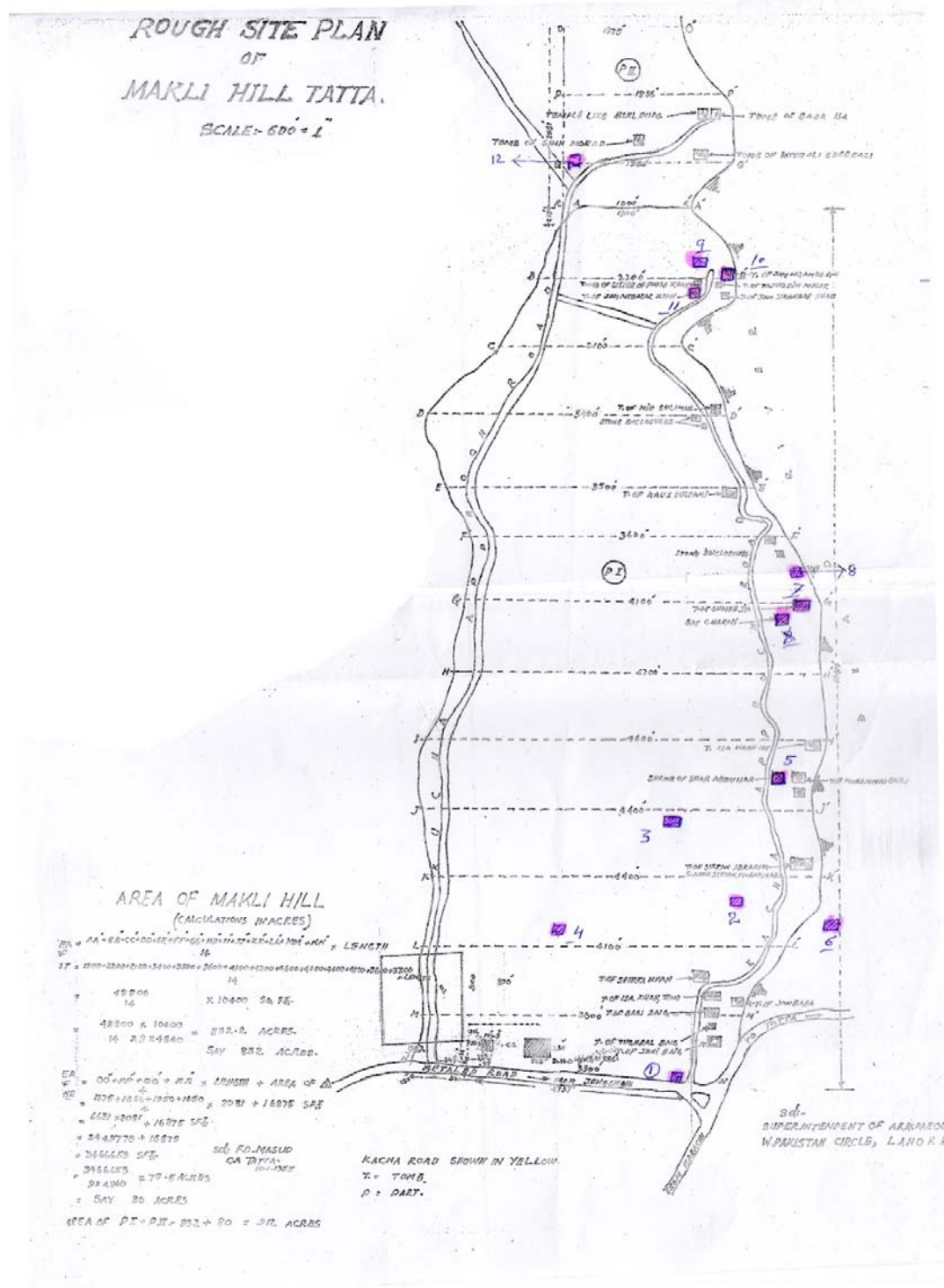


Figure 3 - 1) Shah Abdul Karim Bukhari, 2) Junman Shah Jalali, 3) Fazal Shah Qadri, 4) Shah Parian (women's shrine), 5) Abdulla Shah Asabi, 6) Shah Gudroon, 7) Shaikh Geo, 8) Bibi Shirin (near Shaikh Geo), 9) Mai Makli, 10) Jam Nizamuddin tomb, 11) Dulah Darya Khan, 12) Mula Lutter



Figure 4 – The active shrine Shaikh Geo. Impromptu meetings were held to discuss the management issues on-site. This included the use of new material finishes on site, litter surrounding the entry and the need to communicate any issues with the new site manager.



Figure 5 - A key management objective is discussing maintenance, conservation and litter removal with those responsible for each individual shrine. These were visited over a period of one week in January, 2017.

Systematic monitoring of some monuments had already begun in the fall of 2016 with an initial inspection of every monument. This was conducted again in January, 2017. A calendar of monthly visits to each monument is to be included in this provisional plan. As part of improving site management several capacity building sessions were conducted in January 2017 including documentation, condition assessment, monitoring and materials. This is described briefly in this report but in greater detail in a separate report – Capacity Building at Makli. Additional training opportunities are actively being sought. This includes improving the library on site, distance learning, consideration of additional training onsite and an ongoing search for international training opportunities such as at ICCROM.



Figure 6 - Group C near Jam Nizamuddin. Vehicular traffic has been managed and automobiles are no longer able to park next to this endangered monument. This approach must be extended throughout the site. These low cost, high impact decisions were discussed in January as being very beneficial to the site not only to control traffic but also to control rubbish and improve appearance.

FOLLOWUP - This provisional management plan must be finished and realistically address the urgency of interventions needed. A plan in the form of a spreadsheet (Excel) would be a first start in planning the numerous projects currently underway and planned in the immediate and short term. This would also help communicate to others the ongoing projects as well as complexity of the site. It would also assist in the tasks that are more urgent and those less urgent or for aesthetic presentation.

2. Security

With any site as active and extensive as Makli security is a major issue. This has been exacerbated by limited mobility on the site. Many areas were too difficult to reach with the one 4 x 4 available to the site manager. Security guards were often on foot in 40+ degrees. Therefore the Department of Antiquities purchased 4 motorcycles to be used exclusively for the security patrols. A schedule within the provisional management plan will outline their schedule and inspection routine. In addition the current office facilities and living quarters for the site manager are being renovated. This includes access to fresh water and two new cisterns for back up water, bathing and cooking facilities and electricity. The main entry has been closed and the only official access now is through this complex and this should aid with security. Currently the public know of this access and it is estimated that 90% of all vehicular traffic passes by the site manager's office. The site manager intends to relocate his family to this complex and there will be someone on site 24 hours per day 7 days per week.

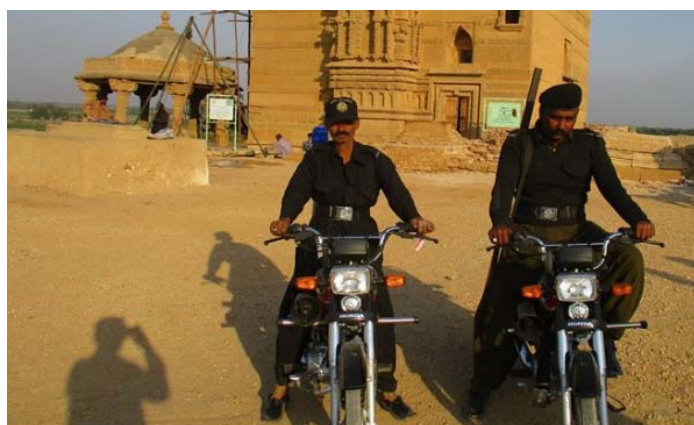


Figure 7 - Four new motorcycles were purchased to patrol the site

In addition to security patrols areas of individual monuments including the main gates as well as access stairs to roofs and upper level galleries will be provided with locked doors. A workshop has been established on site to build doors and window screens. Some temporary doors have been installed to limit access to the roof areas however there is much more work to be done in this regard. Security cameras and CCTV signs will be investigated at more problem areas and were discussed at length during the management plan meetings. This will be highlighted in the recommendations section.



Figure 8 - Temporary door to the upper gallery at Mirza Esa Khan Turkhan (Sani) and the wood workshop on site.

FOLLOWUP – A schedule and routine for the motorcycle patrols is necessary and a check or verification system to ensure they are completing each round. This could be done with a series of sign in sheets distributed throughout the site at each group in secure locations such as the weather station enclosure at Group C. These locations could also serve as rest stops for the guards. The doors to the upper levels of all monuments must be finished and a system of locks installed with a master key for the site manager. These should take precedence over the doors to other structures.



Figure 9 - The existing office complex has undergone renovation and will house the site manager and security

3. Barrier Wall

A barrier wall at the western boundary of the site is of critical importance. There is significant encroachment at the western edge of the site with numerous families living within the property boundaries. While this wall has already been partially constructed there remains several large gaps. This is a very sensitive issue as the families have been living within the site for many years and must be relocated. This requires inter-ministry cooperation as the families must have secure alternative housing. The Department of Antiquities has been working with the Ministry of Housing to provide this housing. When this has been accomplished it will be possible to complete the barrier wall. Should it be completed now it could possibly block people from reaching their homes. Once the Ministry of Housing has relocated these families the survey team from the Department of Antiquities will resurvey the site and determine where a new gate can be installed and the boundary wall completed. Then this survey and new site plan with new buffer zone will be submitted to the World Heritage Centre and World Heritage Committee for redefined property boundaries.



Figure 10 - Although the barrier wall is incomplete the foundation extends near the encroachment along with raw building materials

FOLLOWUP – At the ministerial level the encroachments must be addressed. At both the western boundary and eastern boundary. The encroachment at the eastern boundary are even more of a concern as this is the location of a market. This must be done in a sensitive and delicate way with frequent communications with the communities and religious leaders before construction of the barrier is resumed. Once this happens then the site should be resurveyed and the plans resubmitted to the World Heritage Centre and World Heritage Committee.

4. New Burials

This is also a sensitive issue as the surrounding communities see Makli not as an archaeological site but as an active cemetery and as a place to bury their family members. Many family plots within Makli are still within living memory and it is difficult to enforce or control barriers. However, with increased security, improved communication and an on-site manager along with an alternative burial location this is being better managed than one year ago. An alternative burial place has been selected at the western boundary of the site. This topic requires further in-depth study.

5. Trash Removal

Trash removal has been a large project yet one of the easier aspects to implement on site. While it does not directly relate to conservation, nevertheless, it is an important part of improving site appearance. This has been a multistep approach including:

- a) Observation of problem areas and the purchase and installation of trash receptacles to these areas
- b) Purchase of a truck and establishment of a regular routine to empty the receptacles,
- c) Cleaning of the site of existing litter and vegetation
- d) Discussions with those responsible for regularly used shrines to keep the area free from rubbish. This will take additional time to change the current customs.
- e) Graffiti removal from monuments.

This began with observation, purchase and installation of trash receptacles. Over 40 of these have been installed at key location throughout the site including the pedestrian entrances, vehicular entrances, areas where people eat or purchase items, the more visited monuments and at active shrines. 20 of the receptacles have been kept in reserve to deploy once sufficient continuing observations have been made as to continuing trouble spots. While these are not exactly unobtrusive they are easy to unload and keep the trash away from animals and dry. They also have attracted attention notifying visitors that they should be used to keep Makli clean. In order to keep the receptacles empty a small truck was purchased and makes the rounds of all areas daily. The trash is removed off site to a landfill owned by the Department located approximately 2 kilometers away.



Figure 11 - Trash receptacles in reserve and installed on site, while not exactly unobtrusive they have notified visitors to keep the site clean.



Figure 12 – Left, discussion with those near active shrines to keep the site clean. Figure 13 - Right, small truck purchased to empty receptacles



Figure 14 - Trash receptacles have been installed at trouble spots where visitors enter the site and at active shrines



Figure 15 - The site has also been cleaned of rubbish and undergrowth. This helps deter future litter as well as reduce unwanted animals feeding on site. Additional work must be done to establish a method for long-term control of vegetation on site.



Figure 16 - Graffiti removal on site

Undergrowth as well as litter was removed and this has uncovered previously unknown or undocumented grave markers. The removal of undergrowth will keep windblown litter from collecting on site as well as deter grazing animals from entering the site. There will be further recommendations to keep the undergrowth under control with some form of bio agent. Graffiti removal was also conducted throughout the fall of 2016 and in January, 2017. This involved using distilled water and soft brushes to remove the majority of the graffiti as it was simply chalk. Spray paint graffiti and glued announcements were more difficult and these were removed by vigorous scrubbing with nylon brushes.

FOLLOWUP – Litter and graffiti will be a continuing issues for the foreseeable future. It will take diligence and education to keep the rubbish and graffiti problems under control. It would be very beneficial to keep talking on a regular basis to those responsible for the individual shrines and constant and consistent removal. Posting of signs could also help along with the installation of security cameras at the more problem areas. These were discussed on site during the management planning and will be investigated further.

To address the undergrowth problems investigations must be conducted for use natural herbicide to limit the growth of the damaging plants. It is not sufficient to only remove the upper leafy branches as they will regrow from the established roots. Such treatments could include vinegar, boiling water or removal of the roots.

6. Weather Stations

There is currently no data on wind direction or intensity, rain fall or other environmental factors affecting the site. It has been stated previously in numerous other reports that a major threat is windborne abrasive particles including salt. While this is a reasonable assumption there is no data to support this. One solution proposed is the planting of trees along the western or even eastern borders of the site. As this is an expensive proposition given the scale of the plantings and irrigation infrastructure it must be based on hard evidence. The installation of weather stations will provide this much needed data. It will also help determine when the site and individual monuments are most at risk from rainfall and the subsequent drainage issues. Many of the monuments are exposed, such as Jam N., and another proposal is to cover them seasonally with temporary coverings to protect the interiors. Weather data could help in determining a covering schedule. Capacity building sessions were held on this topic and there is more information in the report on this topic.



Figure 17 - Training on the use of the weather station. Figure 18 - Installation of one of the three weather station.

FOLLOWUP – These are excellent weather stations, however the data loggers must be installed to record over time the environmental information. The instruments also need maintenance, cleaning, battery replacement and downloading of the data. A person on the staff must be formally assigned to take on this duty. They then must receive an additional day or two of training. The resultant information must then be widely shared.

7. Crack Monitors

The unstable (and unknown) subsurface, poor drainage and failure of original materials or techniques of construction execution at Makli have contributed to substantial differential settlement resulting in numerous cracking within nearly all monuments. This has been known for many decades and there is evidence of this with substantial repairs, reconstruction and old crack monitors. However a lack of continuous records makes evaluation difficult. Therefore it was necessary to begun crack monitoring and nearly all major monuments.

Upon the advice of the last Reactive Monitoring Mission crack monitors were installed at various locations. While still too soon to determine if the cracks are active this is a beginning. They must be monitored on a regular basis. During capacity building sessions and in discussing the management plan it was decided there would be a regular monitoring regimen of these crack monitors. Over 15 monitors were installed in 5 monuments. See the separate report on capacity building for additional information.



Figure 19 – Existing crack monitors installed at key locations including the Tomb of Mirza Jaani Beg Tur Khan, the Tomb of Mirza Tughral Beg Turkhan, and Mirza Baqui Bag Tur Khan.

Figure 20 – Lower right, vibrating wire strain gauge for monitoring the movement of Jam. Nizamuddin are necessary and standard crack monitors are not sufficiently precise.

FOLLOWUP – These crack monitors are useless unless monitored on a regular basis. This must be in the management plan. There must also be more sensitive crack monitors at Jam Nizamuddin. This is the most critical monument at risk as it is located at the very edge of the bluff and has been actively moving since the British Period. Standard Avongard tell-tale crack monitors are not sufficient in this situation. It is clear that the structure continues to move and there must be an intervention. Therefore it is highly recommended that a more accurate monitoring system be installed such as a vibrating wire strain gauge with an accuracy of .01mm of movement. This is detailed further in the recommendation section.



Figure 21 - in January, 2017 five new interns began training at Makli. Here they are learning to monitor the cracks on the top of Jani Baig

8. Geotechnical investigations

Of critical importance to the immediate threat to Jam Nizzamuddin is an understanding of the underlying geology. This is also necessary for an understanding site wide and long term stability of other monuments. Any planned interventions must be informed by this information given the number of monuments undergoing differential settlement. Such information would, for example, inform the engineers of the load bearing capability, presence of expanding clays and ground water of the geology. This would inform the design of the intervention and determine if direct load bearing or friction piles are required.

These geotechnical investigation recently got underway at Jam Nizzamuddin in January. Currently there is a small bore hole in progress just to the north of this monument. A report will be forthcoming shortly.



Figure 22 - Geological investigation team at Jam Nizzamuddin in January

FOLLOWUP – This investigation and report is essential. As there are numerous less significant monuments suffering from the same problem. As soon as this report is complete it should be sent to the World Heritage Centre. In addition the Geological Survey of Pakistan has substantial data concerning the geology at a macro scale for Sindh. This information, while not public, should be officially requested. The Survey was contacted during January however there was no reply.

9. Emergency stabilization

This section of the report outlines the activities on site to stabilize the monuments in danger of collapse. As of January 30, 2017, 6 monuments are being actively conserved. This includes both major and minor monuments. While the Reactive Monitoring Mission report specifically mentions Jamia Masjid and Jam Nizamuddin these are special case and require in-depth knowledge of the geology and lengthy discussions with international experts and the local conservation community. For these very significant monuments work must progress slowly. Therefore the decision was made to address other monuments. These include the works referenced below.



Figure 23 - Consolidation work in progress at the wall south of Mirza Tughral Beg Turkhan



Figure 24 - consolidation of the masonry at Meran Bai (Unknown) Tomb



Figure 25 - Emergency structural measures at the Lali Mosque/Tomb



Figure 26 - Shoring under one of the remaining domes at the Lali Mosque / Tomb



Figure 27 - Consolidation of masonry in place at Ghairat Khan

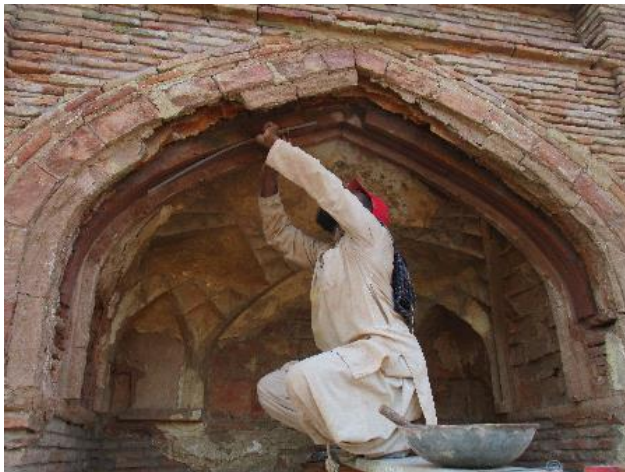


Figure 28 - consolidation work underway at Khwaja Abdul Latif



Figure 29 - Inspection at a small unknown tomb with intact dome near the entry gate



Figure 30 - installation of pavers for water protection at the platform within the Baqi Beg Tomb



Figure 31 - Before and after images at a minor structure near the main gate. This space could be used to store building materials as there is no evidence of tombs here

FOLLOWUP – There is a significant amount of work that has been done to stabilize the structures that were at risk. This should continue but with caution. ALL new materials must be tested for compatibility and salt content. During January the management team discussed a field salt test and this is in progress. A simple field test for salts will be sent to the UNESCO office shortly. In addition there should be a more systematic method to document the ongoing work.

10. Fallen original fabric

Within such an extensive and fragile archaeological necropolis there are with numerous decorated mausoleums. Most of the more significant monuments were decorated with glazed tile, plaster renders and sculpted stone. Because many of these monuments are exposed to the weather these elements have become detached and are at risk of being lost or taken as souvenirs. Therefore it was necessary to develop a procedure for collecting these detached elements. This procedure was strongly recommended by the local UNESCO office in Karachi as well as the Reactive Monitoring Mission of April, 2016. A capacity building session was held and this is documented in a separate report.



Figure 32 – At the building near the entry some materials and decorative elements are carefully stored on site until conservation works can proceed



Figure 33 - a capacity building session was conducted in January to establish a procedure for safeguarding fallen decorative elements



Figure 34 - This included documentation, cleaning and removal for storage



Figure 35 - careful packing and storage at the conservation office



Figure 36 – Before and after storage spaces have been cleaned and made ready for original or new material

FOLLOWUP – There has been significant progress on this topic. However there are still some area of loose decorative material. Within structures and in the open areas. The procedure established in January should become an official part of the provisional management plan. An inventory should eventually be established of these loose materials. They could form a small exhibition at the future visitor centre.

11. Documentation

Better documentation is absolutely necessary for all of the monuments at Makli. During the autumn of 2016 and in January 2017 documentation was begun at the most urgent monuments. This involved the survey team of 4 professionals including photographer from the Department of Antiquities. During 3 months they surveyed with total station 18 monuments. Thins included: the Lali Mosque, Meran Bai (Unknown), Mirza Baqui – Baigtur Kahbn, Mirza Tughral Gag Turkhan, the Canopy south of Jani Baig, Bara Dari, Masoleum of Sultan Qous, Tomb of Jumman Jatti, Malik Rajpal, Jamia Masjid, Hamshera Fateh Khan. This included floor plans, sections, elevations and photography. There were indications of materials, original remaining decorative surfaces. From this limited plans were created for emergency conservation measures were developed. These are good documents and an excellent start to recording all monuments at Makli however they can be improved with additional notes and graphic recording a full condition survey and more in-depth damage assessment. This was discussed at the capacity building sessions held in January (see the separate report on capacity building) and how this documentation relates directly to the important attributes of the OUV. They can also be improved with additional instructions to the survey team and the use of rectified photographs. An additional improvement is the inclusion of the historic photographs discovered during the renovation of the site offices. These must be scanned and shared with the Department’s central office in Karachi. A scanner must be purchased.

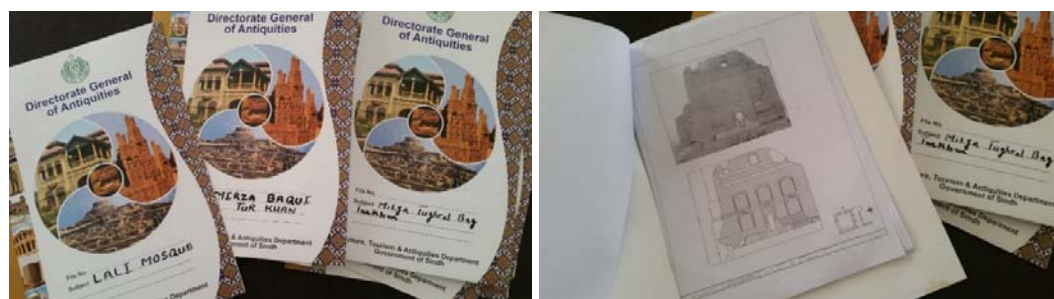


Figure 37 - Documentation included surveys with total station and photography. These have been placed in the office of the site manager.

Figure 38 - Examples of photographs, façade drawings



Figure 39 – On going documentation could be improved with the inclusion of historic photographs. A scanner will be purchased to digitize these images.



Figure 40 - the on-site documentation area after (left) and before (right)

The digital AutoCAD files that included the site plan and individual floor plans of the major monuments were also recovered. During January the staff worked together to install replacement CAD software to access these important files. The site manager has requested from the Heritage Foundation Pakistan their digital site maps.

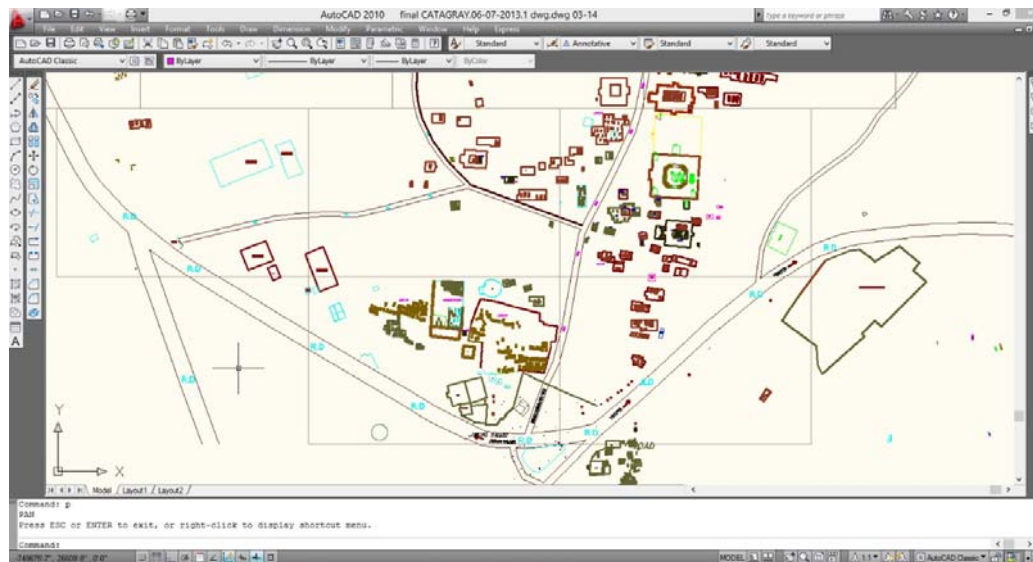


Figure 41 - AutoCAD site map has been recovered and is now in use on-site – this is group A

FOLLOWUP – Documentation is necessary and it will take time to establish a procedure. It will also take time to gather all the documentation together into one place. This includes improving the condition assessment and materials mapping, scanning the historic photographs on site, any historic photos in the museum or archives in Karachi as well as obtaining all the data from the Heritage Foundation. All photography should be rectified and reproduced in the same scale as the drawings. Additional training is absolutely necessary in order to manipulate, manage and query this data. See the recommendations section for more ideas to improve this topic. All documentation from the Heritage Foundation should be obtained.

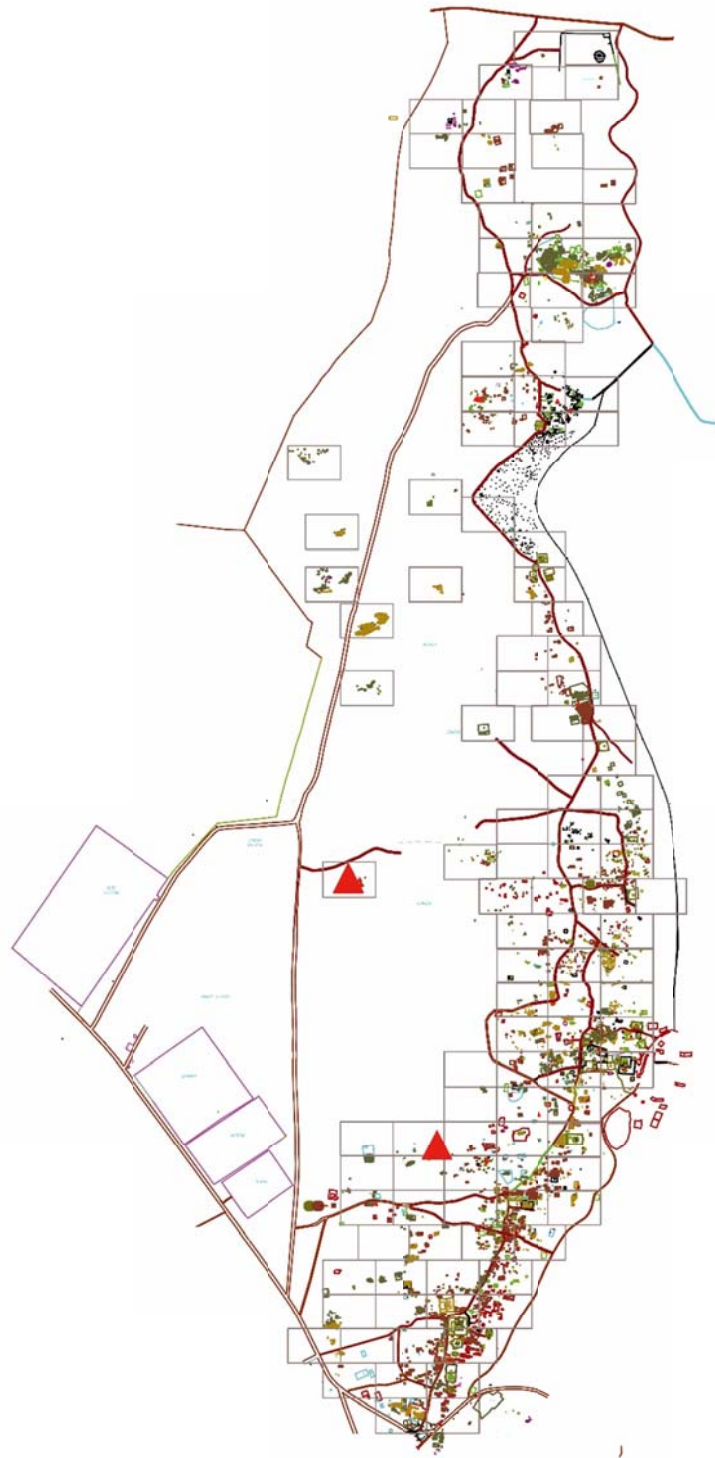


Figure 42 - CAD map of the site which includes the plans of individual monuments and their names has been recovered and is now being used on site. Limited training was conducted in the use of an AutoCAD replacement software – NanoCAD..

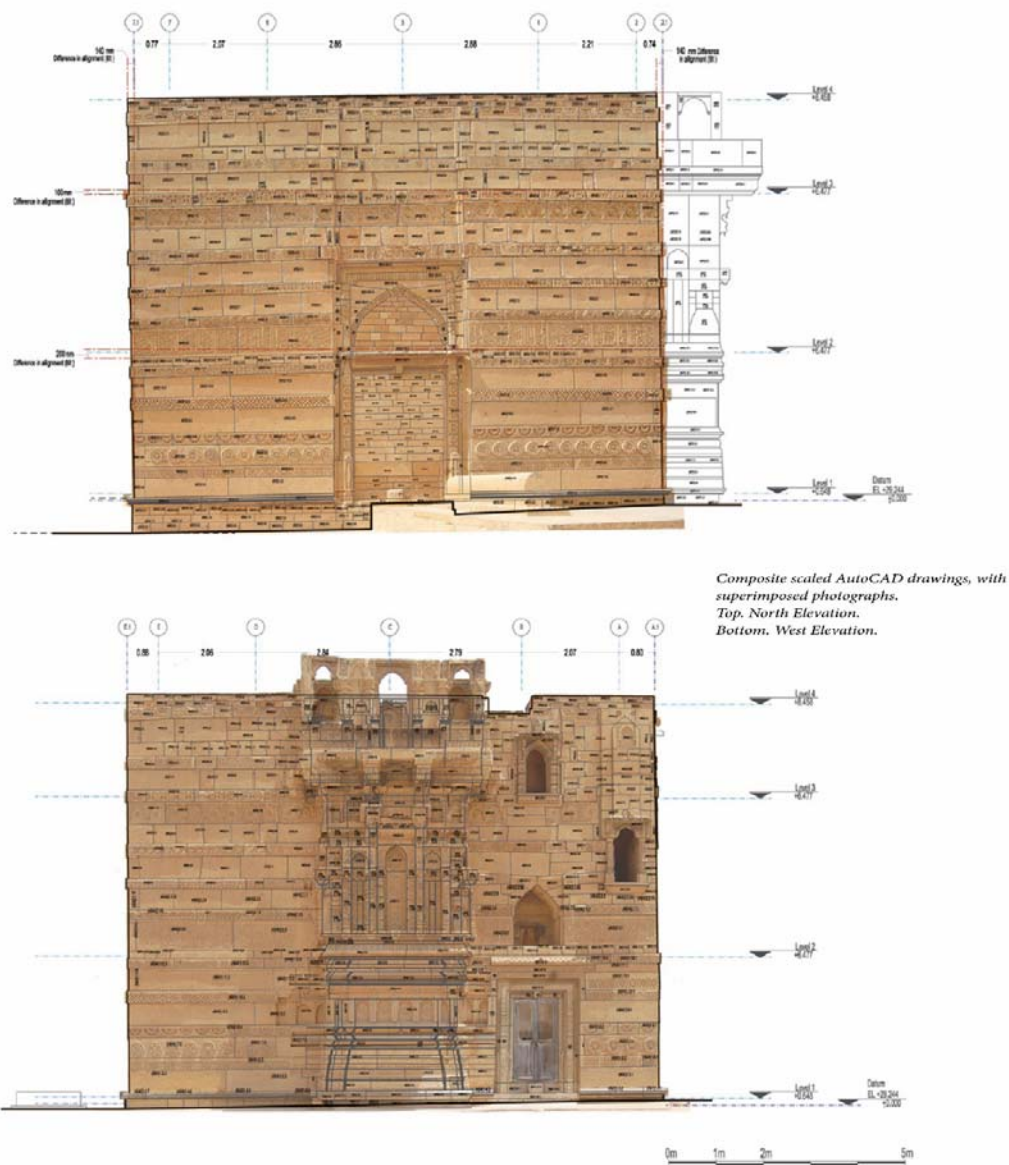


Figure 43 - Documentation work at Jam Nizamuddin by the Heritage Foundation Pakistan. This is the level necessary for most monuments at Makli and should be seen as a goal for the survey and management teams. In addition, this documentation in digital format should be provided to the site manager for use at Makli.

12. Resumption of work at Sultan Ibrahim Mausoleum

The non-profit foundation Heritage Foundation Pakistan has worked on numerous projects at Makli. (<http://www.heritagefoundationpak.org/mi/1/World-Heritage-Site--Thatta>) These include emergency work at the Tomb of Samma Nobil (Supported by the Prince Claus Fund), the Tomb of Jan Baba (Supported by the Federal Republic of Germany) and the Sultan Ibrahim Mausoleum (Supported by the US Ambassador's Fund for Cultural Heritage) and documentation including bore holes and geological studies at Jam Nizamuddin. Due to disagreements concerning the conservation approach the work was temporarily halted at the Mausoleum. This issue has since been resolved and work has been permitted to proceed at this site. During January some limited work was observed at the Sultan Ibrahim Mausoleum that included repointing at the gate and two stone masons at the entry. A staff member, from the Department of Antiquities Government of Sindh has been appointed to be the lesion with all work undertaken in collaboration with the Heritage Foundation. His assignment includes working on the teams from the Foundation and reporting to the site manager.

FOLLOWUP - There should be regularly scheduled meetings between the Heritage Foundation and the site manager along with a regular exchange of information. Currently the documents, test results, geological tests, etc. reside with the Heritage Foundation. Now that a lesion has been appointed and the site office is in order all documentation necessary for conservation work should have duplicates on site. In addition, the main door to the mausoleum requires repair in order to keep visitors out and off the scaffolding.



Figure 44 - Some limited work was observed during January, 2017



Figure 45 - This included two stone masons at the workshop located near the entry

Requiring Immediate Consideration and Implementation by 2019

This section addresses the longer term recommendations from the Reactive Monitoring Mission of April 2016. These recommendations were discussed during the fall of 2016 and on site in January and many had already been included in the longer term Master Plan. However some elements were recently addressed as they are important in the shorter term and will be included in the provisional management plan. Recent updates are briefly described here.

Management

1. Develop and install consistent signage. This is being addressed in the larger Master Plan and it not urgent at this time. The recent and recovered documentation including the Autocad sitemap will be very useful in creating a brochure or other lower cost implementation before beginning a site wide signage programme.
2. Visitor Facilities, toilets, rest stops, information kiosks. The central office, documentation centre and storage units have been renovated and upgraded. The guest house has already been upgraded and includes a solar electrical system in times of electrical outages. A new fresh water supply line is being installed. Because there is one existing foundation next to the guest house the current plan is to convert this into guard housing and a toilet.
3. History of Burials and amendment to statement of OUV. This is not urgent at this time. However over time as the urgent stabilization work is being complete this will get underway.
4. Future structures within the buffer zone and 5 year plan for phasing out and relocating. This is being addressed at the ministerial level. Existing structures that are non-contributing have been considered for demolition. This includes the water tower. It currently does not function and will improve the appearance of the site from the entry.



Figure 46 - There are plans to remove the water tower – however after urgent conservation works

Conservation

5. Clear standards and mechanisms for supervision of ANY AND ALL interventions. These are being developed along with capacity building of the staff. This will take time.
6. Process for Prioritization of work and budget allocation. A budget has been allocated and a list of priorities made. This, of course, begins with the most urgent structural stabilization and most significant monuments. The prioritization of work was clearly addressed in the Reactive Monitoring mission of April 2016 and this was the starting point for this work.
7. Prioritize principal monuments. This has been done. However complex geotechnical problems such as those at Jam Nizamuddin require a large multidisciplinary team and will take additional time.
8. Create extensive baseline photographic documentation. This has begun and will be improved with rectified photography and the scanning of historic photographs discovered on site.
9. Use baseline photography for annual monitoring of visible changes. This is being addressed and has begun with the current work. There is a digital single lens reflex camera on site as well as a survey team for the Department of Antiquities.
10. Develop and implement appropriate drainage system. This is being investigated.

Capacity Building

11. Increase expertise of the Department. This was begun in January, 2017 and this is detailed in a separate report. This included creating management plans, conservation standards and documentation.



Figure 47 - Capacity building has already begun. A training session in Perspective Rectifier and NanoCAD

12. Identify and/or hire key staff. A new site director, Serfraz Nawaz Jatoy, has been assigned. He has recently undergone training for archaeological conservation in France and has experience at other necropolis in Sindh. He will relocate with his family and will live on site in order to more closely manage Makli.
13. Create awareness to facilitate the decision making process. This is underway.
14. Establish a documentation center. This has begun with the cleaning, renovation and reestablishment of the offices on site. A bibliography (a portion of which is included in this report) has begun and additional key documents in digital form will be sent to the site. This includes general conservation documentation as well as specific information related to Makli.

KEY RECOMMENDATIONS

Retain and support existing team

The existing team has made a very good start and must be permitted to complete their ongoing work. They now know the site, its monuments, the individuals responsible for each of the 12 active shrines, the community leaders, and importantly, the problems. They are in the best position to continue the work detailed in this report.

In order to improve their work they must maintain the current rate of progress in addressing the emergency situation as well as medium and long term conservation efforts. They must also have significant input into the Provisional Management Plan and be given time to outline their plans and describe the work necessary. They must also continue to build capacity and knowledge of conservation, cultural heritage management as well as visitor studies. For this they must be ensured of a continued and reliable budget for which to plan. It is understandable that some years the budget must fluctuate however at this critical point a consistent allocation of financial resources would be very beneficial to the site conservation and also to the Department of Antiquities in general.

This existing team must also frequently report their progress as well as any issues to the World Heritage Committee and World Heritage Centre. This will reassure concerned parties that they are addressing the needs of the site and making progress toward good conservation and management practice.



Figure 48 - The current team has met and discussed conservation issues at all of the 12 active shrines within the World Heritage property

Geotechnical investigations / Jam Nizamuddin

Geotechnical investigations – These studies must be completed immediately in the area surrounding Jam Nizamuddin. They are less important for the entire site but should eventually be completed beginning near other less significant tombs. These investigations will give a complete picture of what is happening under the ground and can greatly assist in anticipating problems such as those faced at Jam Nizamuddin. In addition to this all material in a digital form should be obtained from the Heritage Foundation Pakistan. During a review of their condition report it was noted that there is a photograph of a boring machine. The Foundation may have conducted their own geological investigations and may have additional information regarding the subsoil.

At Jam Nizamuddin, because of the differential settlement and decades long slope stabilization problems there should be installed highly accurate vibrating wire digital crack monitors before any drilling for samples and definitely before or ANY intervention. These highly accurate, min. 0.02mm movement, monitors should be closely monitored for any movement. They can be fitted with loggers that are weatherproof to monitor the monument for the long term. The minimum number required is two installed at the roof however four with two additional monitors at the walls would be better to form a more complete picture. While these precise monitors may seem expensive (two at 1,663.10 US see annex for a quote from RST Instruments of Canada) they are relatively inexpensive with compared to any intervention planned.

In addition to the geotechnical investigations and crack monitors all cracks in the foundation in the base surrounding the mausoleum **MUST** be sealed to prevent further infiltration of water and control all drainage on site around the structure. This will prevent any undercutting or unseen erosion under this foundation. Consult foundation engineers for designs to stabilize the structure including research into qualified companies in Pakistan that could sensitively install micro pile or other solution to the differential settlement. Eventually extend these geotechnical studies to the entire site.



Figure 49 - existing crack monitors show a movement of between 2.3 and 3mm. However it is unclear when this crack monitor was installed

Conservation Laboratory

A simple Conservation Laboratory must be created on-site for material testing. Such a capacity could test for any salts within new materials such as sand, lime mortar, water and brick. This testing lab should also be able to perform analysis of historic materials such as the of lime/sand ratio, ratio of brick dust for color matching with historic plasters and compatibility with new materials. Equipment need not be expensive and could be slowly collected. This would include salt testing litmus papers, microscopes, mortar a pestle, scale, furnace, water filtration system, vacuum, table and labware. The site has sufficient space in which to house a Conservation Laboratory and investigations are being conducted now to advice the on-site team. Such a Lab could serve as a regional resource to advise other nearby archeological sites that are facing similar problems.

Documentation Centre

Documentation Centre – improve and store documentation on site. This includes adding to the library key texts and guidelines concerning conservation as well as specific information regarding Makli. *Obtain all information in a digital form from Heritage Foundation including site plan(s), geological tests*

and reports of bore holes, condition assessments of individual monuments and all relevant information. This has been started with the renovation and cleanup of the site offices however more information must be added. This was discussed during the management sessions in January 2017 and several digital volumes were sent to the site.

This Centre could also hold all relevant information related specifically to Makli. This includes the historic photographs discovered in the site offices. These are a valuable resource in dating change to the site and are of enormous assistance during conservation works. Therefore a good scanner must be purchased to be used in the office and time set aside to digitize all historic photographs.

A Documentation Centre could eventually lead to the creation of a Geographic Information System (GIS) to assist in site management. With such complex sites such as Makli spread out over a large area with hundreds of monument a GIS would be appropriate in managing and scheduling at a variety of scales – from individual tombs to entire complexes and drainage. Such a GIS could also link current and historic photographs with links to the map of the site.

Visitor management

There are a large number of visitor who come to Makli. This number could be in the thousands on Thursday nights or even higher during festivals. However there are no statistics on the number of visitors, frequency of visits, where they go or how they arrive. These numerous visitors have a serious impact on the site and the fragile monuments from their cars to well-worn paths that crisscross the site. They frequently visit the 12 active shrines as well as family tombs. Thus proper visitor management is essential beginning with an education programme for all visitors as to respect to reduce rubbish and graffiti. There must also be some statistics collected to count the number of visitors. This will assist in assigning guards schedule, closing certain monuments at peak periods to reduce impact or conducting outreach programmes. Methods must be investigated for counting visitors including infrared sensors deployed at entrances or through collaboration with a nearby university. In addition private vehicles have a large impact on the site. While the management has already begun to restrict their accessibility on the site more could be done in this respect by further defining paths and roadways. In addition the installation of low cost security cameras and announcements at key points could also reduce the number of issues with graffiti and rubbish. This is being addressed in the larger Master Plan however the team felt it was important to stress in this report.



Figure 50 - The site is heavily used by visitors

Capacity building

Capacity building must continue with further mid-career professional education programmes. This could include on-site training, distance learning, and sending key staff to international training sessions. This includes ICCROM, UNESCO and other opportunities. A list is currently being developed including distance learning and available courses and possible sponsorship. This will aid greatly in continuing to develop and refine the site guidelines for conservation. These guidelines could in the future include illustrated examples clearly understood by managers, inspectors and craftsmen.

Continued funding

Funding for conservation is a continual problem worldwide. Fortunately the current Department is funding the emergency works described in this report. However this funding must continue at a constant level for the foreseeable future to ensure the proper conservation of this important site. Beyond Sindh Government support the search for additional funding sources must be conducted. This includes forming partnerships in order to leverage existing allocated funds. Such partnerships could include foreign and local universities to encourage future needed studies such as visitor statistics. Capacity building funding could be applied for from UNESCO as well as from private foundations. In addition some portion of reliable funding could be from small visitor contribution mechanism. This is unclear at this point but could be investigated. Such funds could be used relied upon for specific conservation projects, site management and capacity building.

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ANNEX

Condition Survey Checklist

The following form was developed at a nearby site by the current management. This has been adopted and adapted to Makli. It will also be included in the Provisional Management Plan with improvements. There are current trials to determine if it is sufficient or more information should be added.

CONDITION SURVEY OF CHAUKHANDI TOMB



- Access of damages & needs of conservation

Photographic Documentation

Western View of TOMB



Estern View of TOMB



DAMAGES



ARCHAEOLOGICAL SURVEY CHECK LIST

1. Site Name:

2. Date:

3. Site Details:

4. Coordinates:

5. Distance:

6. Main Road _____ Branch Road _____

7. Time Period: _____

8. Present Condition:

9. Major Threats

10. Construction Material:

EXTERNAL DESCRIPTION:

INTERNAL DESCRIPTION:

SURFACE COLLECTION:

HISTORY:

RECOMMENDATIONS:

Name of Surveyor:

Quote on vibrating wire crack monitor

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Your inquiry: CRACK METER

Pos	Item Description	Qty Unit	Price USD	Value USD
1	VWCM025 VIBRATING WIRE CRACK METER - 25mm RANGE RANGE TO BE CONFIRMED CABLE LENGTH TO BE CONFIRMED 5M CABLE LENGTH	2		804.00
2	 EL380004 CABLE, 2 PAIR x 22 AWG, OSD, RED POLYURETHANE JACKET 6.35mm Ø NOTE: CABLE ATTACHED TO SENSOR(S) ABOVE.			21.20
3	 DT2011B SINGLE CHANNEL VW DATALOGGER - USB			837.90
3.1	 CUSB2-AM506 CABLE, USB A-MINI B 5PIN 6ft			
	 3.2MIG0280 RESOURCE DVD - data file: users manual only			

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Total Value	1,663.10
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Terms of Delivery	EXW - Maple Ridge, BC, CANADA

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Salt identification notes

The following form was developed at a nearby site by the current management. This has been adopted and



International Course on Stone Conservation SC13

SESSION: Salts and Frost Weathering

INSTRUCTOR: Alison Heritage

TIME: Friday, 17th May/ 9:30 – 11:00 1.5 (hours) & 11:30 – 13:00 (1.5 hours)

SESSION OUTLINE

ABSTRACT

The purpose of this session is to provide the scientific and conservation context for the decay of porous building materials by the action of salts and frost. Salt and frost weathering are phenomena with significant cultural and economic consequences resulting in: the continuing loss of porous building materials, carved stone, wall paintings, and archaeological objects. This session introduces the multidisciplinary nature of the study of salt and frost damage to porous building materials, providing an introduction to this complex topic and reviewing treatment options for salt-laden building materials.

OBJECTIVES

After completing this session you will be able to explain:

- What salts are and where they originate from,
- Why certain salts cause damage and others do not,
- The different mechanisms by which salts and frost damage stone,
- The relationship between salts, porous materials and the environment,
- Why some salts and environments are potentially more damaging than others,
- What the current options are for reducing salt damage,
- The principles of environmental control and the challenges faced,
- The range of methods used to test for salts

CONTENT OUTLINE

In this session we start with basic description of what salts are, where they come from, and what their main damage mechanisms are.

- 1 General introduction to salts & salt damage phenomena
 - DEMONSTRATION: SALT DAMAGE EXPERIMENT
- 2 Main characteristics of salts:
 - ionic bonding; crystalline materials

- basic chemistry of salts
 - different types of salts
- 3 Origins of salts
 - 4 Salt solubility
 - DEMONSTRATION: SOLUBILITY EXPERIMENT
 - Relationship between solubility and temperature
 - 5 Salt damage mechanisms: salt crystallization
 - DEMONSTRATION: CRYSTALLIZATION EXPERIMENT
 - supersaturation and crystallization pressure
 - 6 Freeze-Thaw: this is also an important damage process, the mechanism of which is very similar to salt crystallization damage.
 - 7 Salt damage mechanisms: Hydration state change
 - DEMONSTRATION: HYDRATION STATE CHANGE
 - Discuss hydration state change
 - 8 Summary of the phase transitions of salt/water systems:
 - 1 Crystallization/dissolution/deliquescence;
 - 2 hydration/dehydration

Session 2

In this session we start with a discussion of how soluble salts are affected by environmental parameters (RH, Temperature), to understand how salt damage processes are environmentally activated. Then we take a brief look at salt and moisture transport processes. We also examine the main methods used for reducing salt damage, and finish with a general introduction to salts analysis and sampling issues.

- 9 Relationship between salt phase transitions and the environment
 - DEMONSTRATION: SALT BEHAVIOUR AND RH
 - Single salts: Concept of RHeq
 - a. Relationship between RHeq and salt solubility
 - b. Relationship between RHeq and temperature
 - Salt mixtures:
 - a. Solubility changes in presence of other salts
 - b. Thermodynamic behaviour of salt mixtures
- 10 Physical vs. Chemical damage processes
 - physical damage processes
 - a. phase transitions
 - b. differential hygric expansion
 - c. differential thermal expansion


- chemical salt damage processes
 - a. chemical corrosion
- 11 Optimum conditions for salt damage
 - Rapid drying
 - Rapid cooling
 - 12 Salt and moisture transport processes
 - Re cap moisture transport
 - Salt + moisture transport
 - a. Diffusion
 - b. Advection
 - c. Osmosis
 - d. Salt automigration
 - 13 Treatment options
 - a. So called “Desalination” (salt removal/redistribution)
 - b. salt conversion
 - c. inhibition
 - d. environmental control
 - 14 Environmental control of salt damage
 - 1 Concept
 - 2 Problems
 - a. Salt mixtures
 - b. Non equilibrium behaviour
 - c. Porous materials
 - d. Kinetics
 - e. Practical application
 - 15 Salt analysis methods (low to high tech; pros & cons)
 - Qualitative
 - Quantitative
 - Semi- quantitative
 - 16 Salt sampling
 - Sample types, purpose and restrictions
 - Locations
 - Strategies


READINGS 📖 = Essential reading material 🖨 = Available online


📖🖨 Arnold, A., and Zehnder, K. 1991. Monitoring wall paintings affected by soluble salts. In *The Conservation of Wall Paintings*. pp 103-135. Proceedings of a symposium organized by the Courtauld Institute of Art and the Getty Conservation Institute, London, July 13-16, 1987. Marina del Rey:

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http://193.175.110.91/repository/images/d/dc/RBM%2C_Vol._11%2C_No._6%2C_419-432_%282005%29-Steiger.pdf

 Zehnder, K. 2007. Long-Term Monitoring of Wall Paintings Affected by Soluble Salts. *Environmental Geology* 52 (2): 395-409. <http://www.springerlink.com/content/d83mgt447227h668/>

 Salt wiki portal (<http://www.saltwiki.net/>) (also available in German at <http://www.salzwiki.de/>)

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International Course on Stone Conservation SC13

SESSION: Lab: Salt analysis

INSTRUCTOR: Alison Sawdy-Heritage

TIME: Friday, 17th May/ 14:30 – 16:00 (1.5 hours) & 16:30 – 18:00 (1.5 hours)

SESSION OUTLINE

TASK

Using the following test methods, and referring to the **FLOW CHART** provided below, try to identify the white fluffy stuff you can see on the 4 sample bricks **A, B, C and D**.

NOTE: If you are unsure about a test result, try the same test on a known reference salt for comparison (see **Table of Reference salts**).

Table of Reference salts (for comparing test results)

Salt Name	Formula	Test for ions	Comments
Nitratite	NaNO ₃	Na, NO ₃	
Halite	NaCl	Na, Cl	
Magnesium sulfate (epsomite)	MgSO ₄ • 7H ₂ O	Mg, SO ₄	
Sodium hydrogen carbonate	NaHCO ₃	Na, HCO ₃ ,	moderately alkaline
Sodium carbonate	Na ₂ CO ₃	Na, CO ₃ ,	strongly alkaline
Mirabilite	Na ₂ SO ₄ • 10H ₂ O	Na, SO ₄ ,	pH neutral: try the warming test!
Calcium chloride	CaCl ₂		

Record the results of each test on your worksheet in the **TEST RESULTS** table provided below.

After each test make sure to carefully clean all equipment used: rinse into the waste containers provided with demineralised water, and wipe clean with tissue.

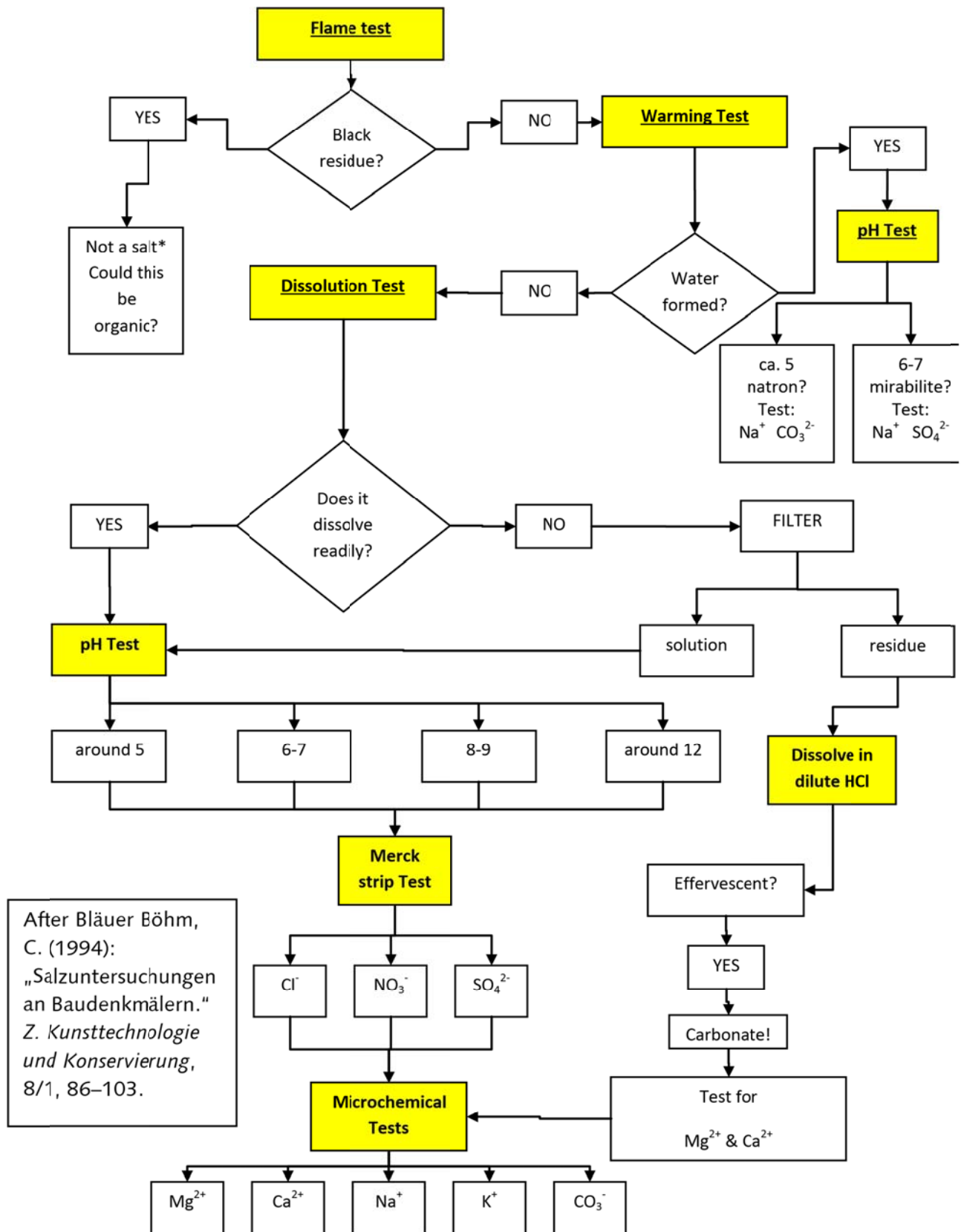
Make sure you label your samples and glass slides etc. clearly to avoid any confusion.

If in any doubt ask!

SESSION OUTLINE CONT'D

TEST RESULTS TABLE

Sample	Flame Test	Warming Test	Dissolution test	pH Test	Merck strip Chloride	Merck strip Nitrate	Merck strip Sulfate	CO ₃ ²⁻ Carbonate	Ca ²⁺ Calcium	Mg ²⁺ Magnesium	Na ⁺ Sodium	K ⁺ Potassium
A												
B												
C												
D												



1) FLAME TEST

White biological growth, such as mould, often looks very similar to fluffy salt efflorescence. This is a useful and quick field test to differentiate between a white fluffy microbiological growth and a salt efflorescence.

- **Caution** Be careful! Do not set fire to yourself or other things!

NOTE: this test is only valid in the context of porous building materials! Salts that occur on porous building materials are generally not flammable, however some organic salts (e.g. those that occur on certain museum objects) are flammable.

The following tests should ideally be performed outdoors, using small samples of material. They should not be performed directly on facades or facade elements.

Tools needed:

Clean scalpel or knife, and a lighter.

Test Method:

Pick up a small amount of sample material using the tip of the knife blade or scalpel. Hold the knife tip with the sample in the *blue part* of the flame (in order to avoid deposition of soot on the sample and the tool do not hold in the yellow part of the flame).



White biological growth, such as mould, often looks very similar to fluffy salt efflorescence. **Mould burns and becomes black, whereas salt melts or**

bursts Mistakes to avoid:

If the sample is burnt in the yellow part of the flame, it will blacken due to soot deposition, even if it is free of organic material!

Other observations:

- Many materials, such as several pigments and stones, change their colour when exposed to an oxidising flame (they become reddish if they are rich in iron minerals, and blacken if they contain organic matter).

Reference salt to use: NaCl

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2) DISSOLUTION TEST

Like test 1, this test is also useful for distinguishing between fluffy salts, and fluffy fungal growths.

- Collect a small amount of sample material on the knife point
- Place in central well of a reservoir glass slide; add a few drops of deionised water (from the small dropper bottle) and stir with a glass rod.
- Observe the dissolution: soluble salts will dissolve readily, however other salts (such as gypsum) are only slightly soluble, and will remain as a residue.

Note: to observe this better, it can be helpful to place the slide on a dark surface

3) WARMING TEST; AN INDICATOR

FOR HYDRATED SALTS indicator for mirabilite

($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$) or natron ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$)

A good simple field test to indicate the presence of mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$) or natron ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) on site is as follows:

- Place a small amount of the efflorescence in a clear plastic sample bag, and hold the bag against a warm surface (warm coffee cup, or in trouser pocket). Examine to see if beads of water develop inside the bag.
- If water drops form, measure the pH with pH-paper: if it is neutral (pH 6-8) then the sample is likely to be mirabilite; if it is alkaline (pH 9-11) it is most probably natron.

Sodium sulfate and also sodium carbonate can exist in a number of different hydrated mineral phases.

Sodium sulfate can crystallize in the form of mirabilite ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$), however above 32 °C mirabilite spontaneously dehydrates to thenardite (Na_2SO_4), and releases its water.

Natron ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) also readily dehydrates.

4) pH TEST: ALKALINE VERSUS ACIDIC SALTS



Photo: Christine Bläuer



Photo: Christine Bläuer

In situ measurement:

- moisten the pH paper with demineralised water
- hold it against the efflorescence, or sprinkle some efflorescence onto the paper - read the value

Laboratory measurement:

- place a sample of the salts on a glass slide, and dissolve in a drop of water
- dip the edge of the pH paper into the drop (if using indicator strips wet the coloured part of the strip with a drop of sample solution). - read the value

Note: Only a general estimation of the pH value is needed:

pH < 5 =
acidic salts
pH 6–8 =
neutral salts
pH 9–10 =
slightly
alkaline
salts pH >11
= strongly
alkaline

The source of alkaline (i.e. pH>8) soluble salts (such as sodium and potassium carbonates) on monuments is always an alkaline building material (or restoration/conservation material), such as cement, hydraulic lime or water glass (Schaffer, 1932; Arnold, 1985). However, if the pH is neutral or acid (≤8) the origin of the soluble salts is not so certain, and can only be determined after more sophisticated analyses (however their origin can still be alkaline building materials).

Many carbonates and hydrogen carbonate salts are alkaline:

- Hydrogen carbonate (HCO_3^-): up to pH 8.4
- Carbonate (CO_3^{2-}): stable above pH 8.4
- Hydroxide (OH^-) : above pH 12

Name	Formula	pH (ca.)
Sodium carbonate (Natrite)	Na_2CO_3	12
Natron	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$	12
Thermonatrite	$\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$	12
Nesquehonite	$\text{MgCO}_3 \cdot 3\text{H}_2\text{O}$	10

Lansfordite	$\text{MgCO}_3 \cdot 5\text{H}_2\text{O}$	10
Trona	$\text{Na}_3\text{H}(\text{CO}_3)_2 \cdot 2\text{H}_2\text{O}$	10
Nahcolite (sodium bicarbonate)	NaHCO_3	8
Kalinite (potassium bicarbonate)	KHCO_3	8

Watchpoint/ common mistakes:

De-ionised water can give a slightly acidic pH value due to its low ion content . Therefore for this test it is better to not use ultra pure de-ionised water, but rather demineralised or even clean drinking water (as long as its dissolved ion content is not too high). Take care also when testing coloured sample materials (particularly those that form a fine suspension in water), that the reading is not confused/obscured by the coloration of the paper with sample itself.

Salt mixtures can produce some problems in that samples containing natron (sodium carbonate $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) with an excess of gypsum will give rise to a neutral solution, rather than an alkaline solution (as expected for pure natron).

If your sample consists of a fine white powder (e.g. from a salt contaminated limestone) it can be interesting to tip a few grains on a damp pH-paper and observe the aureole forming around the grains (e.g. samples containing natron with an excess of gypsum will give a neutral pH in solution but using this method will show a few blue aureoles (i.e. high pH).

5) MERCK STRIPS FOR THE DETECTION OF CHLORIDE, NITRATE, AND SULFATE

Merck strips are a quick easy low cost method for indicating the presence of a range dissolved ions. The results are semi-quantitative, but the accuracy of this depends on the dilution used. Therefore in the field they are best used to give a general indication regarding the presence of specific ions. Test strips exist for a range of different ions, however, the detection limit for many of these is quite high.



Photo: Christine Bläuer

- Collect a small amount of efflorescence material on the knife point
- Place in central well of a reservoir glass slide; add a few drops of deionised water (dropper bottle) and stir with a glass rod.
- Using a pipette, take up some of the dissolved salt solution (leaving any residue), apply a series of drops to the coloured parts of the Merckstrip,. Wait a few seconds, and then compare indicator strip with the colour guide given on the package. Record the result. *Note:*
- *Chlorides: the detection limit is very high so a very strong solution is needed*
- *Sulphates: the detection limit is very high too. Therefore not really good for gypsum (due to its low solubility) depending on how much water used to dilute sample.*
- *TIP: Merckstrips can be cut in half lengthways to cut costs!*

6) MICRO CHEMICAL TESTS

CAUTION: All the reagents used for these tests are hazardous!

Please make sure you are wearing gloves and eye protection at all times.

Familiarise yourself with the relevant chemical Hazard Data sheets.

Avoid any contact of chemicals with skin and especially eyes. Avoid any inhalation.

Handle all chemicals carefully, and dispose of them appropriately in the marked waste containers.

Carbonates (CO_3^{2-})

Acid test for carbonates (salt solution)

- Place a drop of salt solution on a glass slide.
- Add a drop of **dilute hydrochloric acid (1M HCl)**.
- If carbonate is present the solution will start to bubble due to the formation of carbon dioxide gas (CO_2 (g)) and water.

Acid test for carbonates (salt grain)

- Place a grain of salt on a glass slide.
- Add a drop of **dilute hydrochloric acid (HCl 1M)** to the grain of salt.
- If a carbonate salt is present, a vigorous effervescence will be observed, with the exception of Dolomite ($\text{CaMg}(\text{CO}_3)_2$) and Magnesite (MgCO_3), which will only effervesce in the presence of concentrated warm acids.

Sodium (Na^+); Potassium (K^+)

Adapted from Chamot et al 1946

Preparation of the reagent solution

(Not: must always be made up fresh, but can however be used for several tests on the same day):

- Place a glass reservoir slide on a piece of black paper (so you can better see what you are doing!)
- Place **1 small particle** (max. 1 mm^3) of **bismuth nitrate** on the glass reservoir slide.
- Add **1 small drop concentrated sulphuric acid (H_2SO_4 conc.) from the small dropper bottle**
- Stir vigorously for 1 to 2 minutes with a glass rod (bismuth nitrate dissolves slowly).
- Add **1 drop of deionised water**
- When the solution is saturated, the acidic drop will be white, firm and swells considerably.
- Add **1 drop of deionised water** and stir vigorously. The white salt should now almost completely dissolve to form a colourless/opalescent solution
- Add **1 drop 2M nitric acid (HNO_3 2M)**.
- The reagent solution is now ready.

To avoid any accidents during this lab session, please bring JUST your salt sample and a glass slide to the microscope area, to do the test for sodium and potassium (where there is already some reagent solution made up).

Test for Na^+ und K^+ :

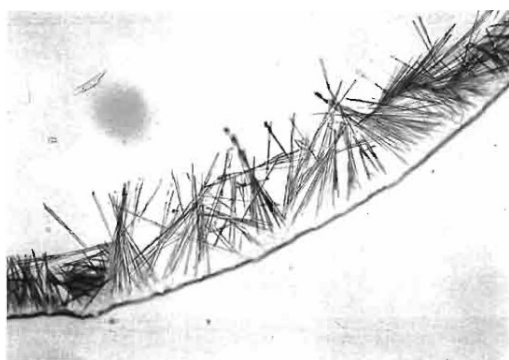
- Place a small grain of salt on a reservoir glass slide (or a drop of sample, which is then evaporated until dry).
- Carefully add **1 drop of the reagent solution to the salt particle.**
- Observe the reaction products under the microscope.
- Na^+ usually quickly forms characteristic tiny rod shaped crystals of sodium bismuth sulphate
($3\text{Na}_2\text{SO}_4 \cdot 2\text{Bi}_2(\text{SO}_4)_3 \cdot 2\text{H}_2\text{O}$).
- K^+ forms (often first after careful warming on a lukewarm heating plate) six-sided platelets of potassium bismuth sulfate ($\text{K}_2\text{SO}_4 \cdot \text{Bi}_2(\text{SO}_4)_3 \cdot 2\text{H}_2\text{O}$), some of which are iridescent (i.e. have shimmering rainbow colours visible under the polarising light microscope).

Watchpoints/ Complications:

- Calcium, barium, strontium, lead, silver, titanium and mercury (Ca, Ba, Sr, Pb, Ag, Tl und Hg) can interfere with the reaction, either impeding or completely preventing the reaction.

Calcium (Ca²⁺)

- Place a drop of salt solution on a glass slide
 - Add **1 drop of 1M sulfuric acid (H₂SO₄) (small dropper bottle)**.
 - Transfer the glass slide to a warming plate, until the edge of the drop begins to dry.
 - Under a microscope, observe the crystals that form at the droplet edge.
-
- When calcium is present, bundles of characteristic needle shaped gypsum crystals will start to form.
 - Detection limit for Ca²⁺ = 0.05 µg.



Indication of Ca : Formation of gypsum crystals at edge of test droplet after the addition of 1M sulphuric acid

Image: Bläuer Böhm, C. (1994): „Salzuntersuchungen an Baudenkmälern.“ Z. Kunsttechnologie und Konservierung, 8/1, 86–103.

Magnesium (Mg²⁺)

Test with titan yellow


This test is very easy and simple! However you should also compare the result with the reaction of a salt solution drop containing calcium ions, because these give a similar but slightly different test result.


- Place a drop of the salt sample solution on a spotting plate
- Add **1 drop of dilute hydrochloric acid (1M HCl)** (small dropper bottle)
- Add **1 drop of Titan yellow solution** (small dropper bottle)
- Then add **1-2 drops of sodium hydroxide solution (2M NaOH)** and stir with a glass rod.
- In the presence of Mg²⁺, a red fluffy precipitate is formed (detection limit ca. ca. 1,5 µg)


Complications:

- *In the presence of Calcium ions produces a light orange-red coloration which is then difficult to distinguish from the fluffy precipitate produced by Mg^{2+} . Compare with the results obtained for a solution containing calcium ions*
- *Nickel, Zink, Manganese und Cobalt ions also disrupt this test.*

READINGS = Essential reading material = Available online

 Arnold, Andreas. 1984. Determination of mineral salts from monuments. *Studies in Conservation* 29 (3): 129-38.

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 Salt wiki portal (<http://www.saltwiki.net/>) (also available in German at <http://www.salzwiki.de/>)



Figure 51 - Mirza Tughral Baig

Capacity Building at the World Heritage Property of the Historical Monuments at Makli, Thatta Sindh (Pakistan)

January 30, 2017



*Culture, Tourism & Antiquities Department,
Government of Sindh (Pakistan)*



This Report has been prepared by Rand Eppich, Conservation Architect, UNESCO consultant

*It is funded by the Government of Sindh,
Culture, Tourism & Antiquities Department*

Figure 1 -Front cover, Mirza Tughral Baig at the edge of the Makli Hill

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Keywords: Sindh, necropolis of Makli, Pakistan, Management Plan, Jam Nizamuddin, Thatta

Project Team:

Serfraz Nawaz Jatoi (Archeological Conservator)

Irshad Ali Rid (Curator)

Aamir Ahmed Memon (Assistant Curator)

Khursheed Ahmed (Chemist)

Zafar Iqbal Warraich (Civil Engineer)

Ashraf Palijo (Draughtsman)

In collaboration with

Kazi Ayaz Mahessar, UNESCO Provincial Coordinator, Sindh, UNESCO Islamabad, Pakistan

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CAPACITY BUILDING EXERCISES

Introduction

Architectural and archaeological conservation takes multiple skills, especially for a site as extensive and with complex issues such as Makli. While the staff has been trained, they are somewhat new to the site and their roles, therefore it was necessary to increase capacity in several areas. Various exercises were held in order to address perceived gaps in conservation knowledge or for newly acquired equipment - all with the overall goal of protecting the Outstanding Universal Value of Makli. This report describes capacity building exercises carried out during the month of January, 2017. Some of these exercises were formal while others were conducted on-site and were more of an informal nature. Most of the on-site staff attended these sessions and if not possible the session was repeated on a one-to-one basis.

It was acknowledged that additional capacity building is necessary and this is further outlined in a later section of this report as well as in the other report – Makli State of Conservation. Following is a brief description of each capacity building session held on site at Makli. These session will be followed up with additional (digital) material sent to the site for the growing library as well as continuing communication with the site management and staff. It was stressed during all these sessions that this is was only a beginning and that this learning curve must continue for the foreseeable future.

Procedure for recovering fallen materials

Many of the structures at Makli have lost their protective roof or dome coverings thus exposing the decorative surfaces within. These decoration consists of plaster, carved stone or glazed tile and once exposed to the elements they often become detached from their substrate. Lying lose they often break or are taken as souvenirs. Thus a brief collaborative session was conducted to document, catalogue and safely store these remaining fragments. This session resulted in a separate report detailing step-by-step the procedure for recovering fallen original fabric, inspection of remaining attached fabric and original non-decorative building materials. This session was particularly important as the Reactive Monitoring Mission of April 2016 stressed that a capacity building session on this topic must be conducted.



Figure 2 - session on safeguarding fallen decorative elements

Weather monitoring

One critical aspect in understanding the decay mechanisms present at Makli is documenting external and internal environment factors/threats. Because Makli is situated a hill, within a wind corridor and near the ocean the environment greatly impacts the monuments. This includes rain and its associated flooding, wind driven sand and salt. However there is no documentation concerning the environment. Therefore the Department, upon the advice of UNESCO, installed three integrated environmental monitoring stations throughout the site. As these instruments and the data they provide are somewhat complex a training was required. This training was held over two days with one day focusing on the instrument and what it could measure and the second day focused upon internal environmental monitoring with a separate system. These sessions included the instrument, its purpose and software. While there still must be one or two days of additional training concerning the software and data analysis of these complex stations and their impact on the site, nevertheless it was a good beginning. It was decided on site that one individual should be responsible for a follow-up process for checking on the instruments, updating the batteries, downloading the data and following the environmental monitoring.



Figure 3 - Installation of the weather station



Figure 4 - Description of the weather station panel

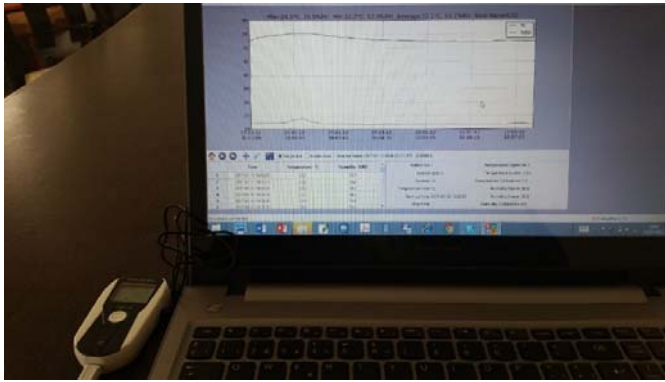


Figure 5 - A capacity building session on interior environmental monitoring was conducted

Additional training was held with internal temperature and humidity devices. It was discussed how this could, in the future, be compared with the external sensors. The software was viewed and how the settings for measurement could be altered. However it was not decided where to install this sensor. The location for this device will be decided in the future. One possible location is within the dome of the Sultan Ibrahim mausoleum. However this location is the site of the ongoing work of the Heritage Foundation and the site team wished to consult with them.

Documentation tools

The need for basic inventories and graphic systems were also discussed. This included the need for Autocad as there is a digital site plan. It was discovered that the site does not have a working license for Autocad. Therefore, an alternative was found that is free called NanoCad. This was tested and the site plan opened and it works as a good alternative to the more expensive Autocad.

In addition to this the on-going documentation was reviewed. The process is that the Department of Antiquities has a dedicated survey team of 3-5 people including a surveyor and photographer. They recently conducted surveys of the monuments about to undergo conservation. This included a floor plan with dimensions and photographs. All produced in Autocad. It was noted that many of the photographs are not rectified, therefore a session was held on rectified photography. A small program called Perspective Rectifier was installed on the manager's laptop computer and training was held with this software. Advice was given to the manager that he should ask for only rectified photographs in the future.

Standards for documentation were also discussed such as a CAD layering convention, naming of monuments, line weights, colours and dimension protocols. While this may seem a more stylistic concern, nevertheless, it is important as the survey will most likely continue for many years and by many different contractors or parties. It was stressed that this convention should be shared with any contractors or non-profits operating on the site.

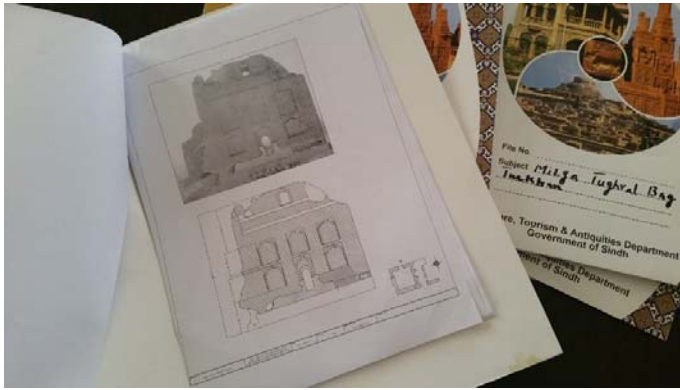


Figure 6 - Existing documentation inspected with concepts on improvement



Figure 7 – A training session on Perspective Rectifier

Geographic Information System (GSI) was also discussed. It was stated that CAD in many times is not sufficient to manage such a large and extensive site. That a GIS is necessary. While there was not time to create a capacity building course on GIS there was time to expose the on-site team to this useful tool. Additional sessions in concerning GIS were later discussed with the UNESCO Karachi office. In addition to this the on-going documentation was reviewed.

Condition assessment

In order to protect the Outstanding Universal Values of Makli a capacity building session was held on conducting detailed condition assessments. It was discussed that the documentation provided by the survey teams of the Department of Antiquities, while accurate dimensionally, they are not sufficient for conservation and do not contain physical characteristics or threats. They are only a base upon which to add more detailed information upon which to make informed decisions. It was shown that photo copies or prints of the photos and drawings could be made and then additional notes and graphics could added such as immediate threats, damages, original remaining decorative finishes or previous interventions. This is one important capacity building session that must continue.

Crack monitoring

Upon the advice of UNESCO crack monitors were installed in various locations at several buildings known to have active or semi-active cracks. Older crack monitors were observed in nearby location either broken or disturbed. These newer two-piece with grid crack monitors are superior to the older monitoring systems in that the magnitude and direction can be observed. These have been installed with silicon. During this capacity building session, held in the field, it was noted that epoxy is superior as there is less movement in addition to screws. It was discussed that the screws should only be used in location without original fabric but that this could also give a backup measurement system with calipers. In addition it was discussed how the date and number of the crack monitor must be marked on site. In the case of the significant Jam Nizzamuddin monument that is actively moving a more precise system must be used. Vibrating wire systems with data loggers were discussed and how these could also be used to measure the building in the future during any intervention.



Figure 8 – Existing crack monitor



Figure 9 - Vibrating wire strain gauge to very accurately measure movement

Salt contamination

During the time spent at Makli it was noticed that the recent interventions at Meran Bai (Unknown) tomb the brick surface began to effloresce (salt appearing upon the surface) just after the works and more appeared after a rain. It was discussed that this was a big concern that the new work contained salts and that these salts could disperse or migrate into the original material below that contained original decorative surfaces including plaster and glazed tile. It was also discussed that the appearance of efflorescence was disturbing visually with the white surface visible from far away. It was discussed that soluble salts are a principle agent of decay in porous buildings and the expansive forces of growing crystals cause the materials to decay. As there is a significant of soft brick and limestone at Makli this is a serious concern. Limestone is generally considered the most susceptible of stones because it contains calcium carbonate and an acidic environment breaks down the carbonates and converts them to sulphates.

The continued discussions centered on the need for testing all materials for salts before accepting delivery and / or installation into historic structures. It was stated that the same batch of bricks was used in other places but did not effloresce and the point was made that it is unknown where the salt came from because of the lack of testing. That the salt could have come from the brick, mortar, sand, water or all of the above. Thus stressing the need for testing.

The training exercise was concerning two topics, further training and how simple field test could be done to test for salts and how to deal with the existing salts now visible in the Meran Bai tomb.

FIELD TESTS – It was debated on site that some materials should be sent to the laboratory for testing. It was agreed that this was the best method and must be conducted for the most significant monuments at Makli. However several other methods were considered. These included field tests as simple as wetting material with de-mineralized water and allowing them to dry in the sun, litmus paper tests and instrument testing.

It was decided at the end of this session that more work in this area must be done and a field test developed and step-by-step procedure developed for work at Makli. This could be an electrical conductivity test, pH test or other methods combined to ensure that no materials containing salt were introduced into the monuments.

SALT REMOVAL – The second part of this exercise was the removal of the salt that appeared on the Meran Bai tomb. It was discussed that masonry surfaces may suffer a short but intense period of salt after work but may stabilize after the immediate supply is exhausted. This could be removed with a dry soft nylon brush then wetted and poltuiced with cotton to remove any salts just under the surface layer taking care to avoid wetting any original fabric below. It was noted that the monument must be carefully monitored.

This portion of the capacity building exercise was not anticipated thus must be continued. The importance of this topic cannot be underestimated and further materials including a field test for salts will be sent with instructions to Makli.



Figure 10 - surface salt removal with a soft nylon brush. Above 1m is the new work and below is a previous intervention



Figure 11 - The surface salt was removed easily



Figure 12 - Meran Bai Tomb after treatment, most salts on the surface following the intervention have been removed however it must be closely monitored. The appearance has been greatly improved.



Figure 13 - Other sites were discussed that had past interventions that have introduced salts into the historic structures such as the tomb of Mirza Jaani Beg Tur Khan



Figure 14 - It was also discuss at the site of the on-going emergency works at the Lali Mosque

RECOMMENDATIONS FOR CAPACITY BUILDING

Additional capacity building is strongly recommended after carrying out these sessions. It was discussed on site and in Karachi that this is a long on-going process. The Department of Antiquities is young and was only formed in 2011 and 2012 after the devolution of responsibility from a national authority to a regional authority.

These capacity building programmes broadly fit into 3 categories.

1. Conservation, including theory, scope of (appropriate) interventions, condition and structural assessment, materials and material testing.
2. Site management, in general, writing of management plans, project briefs and visitor management.
3. Documentation and monitoring including structural and periodic monitoring and computer programs such as GIS, CAD and site photography.

These additional capacity building programmes could be accomplished in a number of ways. These were also discussed during the sessions at Makli and Karachi. The first way is to continue the sessions already begun via communication and suggested readings. Additional digital texts concerning the above topics will be sent to Makli for the on-site library. This fits into the existing work schedule and on-going works currently on site. However, this is not ideal and there are often other pressing matters that must be managed. The second idea discussed was a continuation of session on-site, but more focused, similar to the sessions outlined in this report. It was agreed that this was the most ideal and would be the most focused on the particular issues of Makli. Additional funding will be sought for this capacity building and it could incorporate other experts depending on the evolving needs.

Finally the last idea is international off-site training at organizations such as ICCROM International Centre for the Study of the Preservation and Restoration of Cultural Property, UNESCO or ATHAR or even regional centres such as in Turkey at METU (Middle East Technical University). There was a quick search for upcoming courses that the on-site team or management in Karachi could participant in. Initially nothing was found but it was agreed upon that additional searches would occur and when something comes up the team at Makli will be notified. A list of places to find such course will also be developed.

<http://www.iccrom.org/course-announcements/>

<http://www.getty.edu/conservation/search/browserresults?d=ped>

http://athar-centre.org/?page_id=1471

<http://www.buildingconservation.com/directory/courselist.php?category=Short+courses>

<https://www.architecture.com/RIBA/CPD/WhatcantheRIBAdoforme/AdvancingyourcareerthroughCPD/RIBAAdvancedCPD/AdvancedCPDConservationSkills/RSUATrainingCourseforRIBAConservationAccreditation.aspx>

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Figure 15 – Jam Nizamuddin with the on-site team as well as visitors from the Mehran University of Engineering and Technology , Jamshoro.

Materials Procedure for the World Heritage Property of the Historical Monuments at Makli, Thatta Sindh (Pakistan)

January 30, 2017



*Culture, Tourism & Antiquities Department,
Government of Sindh (Pakistan)*



This Report has been prepared by Rand Eppich, Conservation Architect, UNESCO consultant

*It is funded by the Government of Sindh,
Culture, Tourism & Antiquities Department*

Figure 1 -Front cover, detached tile from within Meran Bai (Unknown Tomb)

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Project Team:

Serfraz Nawaz Jatoi (Archeological Conservator)

Irshad Ali Rid (Curator)

Aamir Ahmed Memon (Assistant Curator)

Khursheed Ahmed (Chemist)

Zafar Iqbal Warraich (Civil Engineer)

Ashraf Palijo (Draughtsman)

In collaboration with

Kazi Ayaz Mahessar, UNESCO Provincial Coordinator, Sindh, UNESCO Islamabad, Pakistan

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INTRODUCTION

Introduction

Makli is an extensive and fragile archaeological necropolis with numerous decorated mausoleums. Most of the more significant monuments were decorated with glazed tile, plaster renders and sculpted stone. Because many of these monuments are exposed to the weather these elements have become detached and are at risk of being lost or taken as souvenirs. Therefore it was necessary to develop a procedure for collecting these detached elements. This procedure was strongly recommended by the local UNESCO office in Karachi as well as the Reactive Monitoring Mission of April, 2016.



Figure 2 – Local Group C including Jam Nizamuddin Tomb. Keeping the site clear of vegetation, rubbish and control of vehicles is a continuing challenge for a much used place.

In January 2017 the Government of Sindh conducted a mission to Makli to evaluate the condition of the site, assist in the preparation of a temporary management plan and conduct capacity building exercises such as developing a procedure for collecting detached and fallen decorative architectural elements. This report is an description of the pilot activity undertaken during this time at the Meran Bai (Unknown) tomb where there had recently been conservation efforts. The team discussed the need to safeguard these elements and when and where to continue this effort.

During discussions on site with the team and site manager it was determined that there are three categories of decorative elements. Each needs a separate procedure.

- 1) Detached decorative elements including glazed tile and sculpted architectural elements.
- 2) Semi-detached elements still en-situ.
- 3) Detached construction elements such as brick, stone ashlar without any surface decoration.

Following are the procedures for each of these categories. It is understood that these procedures are not perfect that this is a working document. That any procedure must evolve and be adapted as this work progresses and for particular tombs.

1. PROCEDURE FOR DETACHED DECORATIVE ELEMENTS

Step-by-Step

This step-by-step procedure was developed while working with the on site manager and the staff assigned to Makli. This process was conducted after a recent conservation effort at the Meran Bai (Unknown) tomb. Every tomb which has decorative elements must be inspected regularly and documented. There must be an inventory maintained of the elements at risk.



Figure 3 - Recording the context

STEP 1a – INSPECTION & DOCUMENTATION – DETACHED ELEMENTS

The site must be photographed overall in order to give context to the detached elements. The entire site must be inspected to locate all detached elements. In this case the detached elements were already collected into a corner of the building to safeguard them from the ongoing masonry conservation works.



Figure 4 - documentation en-situ of the detached decorative elements

1a – the detached elements must be photographed where they are found before disturbing. It was recognized that this may involve only one photograph or multiple photographs.



Figure 5 - inspection of individual elements

1c – Each element must be inspected and notes taken as to their description, condition, site, location, etc. A form will be developed to outline these notes.



Figure 6 - determination of the detached elements' original location

STEP 2a – INSPECTION OF ATTACHED ELEMENTS

The detached elements must be compared to the remaining attached elements and documented.



Figure 7 - inspection of remaining elements

2b – the remaining elements must be thoroughly inspected to determine if any are loose or about to become detached. If they are about to become detached then the procedure for semi-detached elements must be followed (part 2 of this report).



Figure 8 - careful cleaning of each element

STEP 3a – CLEANING & DOCUMENTATION

Each decorative element must be cleaned, front and back, with a dry soft nylon brush taking care not to detach any remaining glazing.



Figure 9 - arranging for documentation

3b – each element must be inspected and arranged for documentation.



Figure 10 - assigning an index number

STEP 4a – INDEXING – each element will be given a unique code number starting with the name of the monument and a sequential number.



Figure 11 - review of the index and organization for photography

4b – this is to be done on the back of the element.



Figure 12 - arrangement for photography

4c – Each element is to be placed face down and photographed with a high resolution camera in order to read the index number.



Figure 13 - reversing each element in place for photography of the decorative face

4d – Each element will then be placed decorative face up and photographed again.



Figure 14 - careful packing and storage at the conservation office

STEP 5 – STORAGE – the elements are then to be placed into a wooden or plastic box carefully and separated with packing material then transported to storage.



Figure 15 - The same procedure applies to carved stonework

The same procedure above applied for detached decorative architectural elements such as this column from the same site.

2. PROCEDURE FOR ATTACHED DECORATIVE ELEMENTS

Inspection

As with the detached decorative elements there was a procedure required for loose elements that are about to become detached.



Figure 16 - inspection of attached decorative elements

STEP 1 – INSPECTION & DOCUMENTATION

The detached elements must be compared to the remaining attached elements and documented. The entire decorative surface must also be documented through photography, sketches and notes. These must include the state of condition, written description, name of the inspector, monument and date.



Figure 17 - inspection and consolidation of remaining decorative elements

STEP 2 – the remaining elements must be thoroughly inspected to determine if any are loose or about to become detached elements.

STEP 3 – CONSOLIDATE – the remaining elements that are at risk of being detached are to be consolidated and stabilized. The site must be placed on the list of inspected sites and important for its decorative surfaces.

3. PROCEDURE FOR NON-DECORATIVE ELEMENTS

Projects

This is the majority of elements that remain on site that are out of their original position includes cut stone and brick. Most of the time these are fractured or in pieces but many times there are complete whole elements. These are not at risk from theft as they are not decorative and usually larger thus more difficult to move. They are also not as significant as the decorative elements. The procedure developed here is intended to reuse many of the materials as wall or arch collapses usually results in the elements close by to their original location. The intention is for Anastylosis – or replacing these elements back into their original position.



Figure 18 - Unknown tomb Group A - fallen brick capping was replaced

STEP 1 – DOCUMENTATION AND INVESTIGATION

This is a critical step in order to determine the original location of the construction elements. This includes photography of the context and of the fallen elements from multiple angles. It must also be accompanied with copious notes and sketches. Sketches are essential as it is a selective form of documentation and only those elements that are important can be documented.



Figure 19 – documentation by photography and notes of original material location

STEP 2 – CLASSIFICATION AND CHARACTERIZATION

This second step is just a classification and characterization of the building materials and their suitability for anastylosis. This classification determines their original location in the building based on the previous documentation and location, acceptability for reinsertion. In many cases fractured original materials can be used for rubble core walls but this determination must be made on a building by building basis.



Figure 20 – classification of on site of original building materials in preparation for an intervention



Figure 21 - examination of original en-situ materials and fallen materials

STEP 3 - STORAGE

It was determined by the team that these construction elements should be stored on site. This is due to three main reasons. 1) They can be used during upcoming restoration efforts, 2) They are not in great risk of theft and 3) there is limited storage space and the decorative elements must receive priority.



Figure 22 – longer term storage on site or within the structure.

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