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# Moenjodaro UNESCO Emergency Mission Following Disastrous Rainfall in 2022: Intermediate Progress report

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# Moenjodaro

## UNESCO Emergency Mission Following Disastrous Rainfall in 2022



Thierry Joffroy

CRATERRE – AE&CC, ENSAG – Univ. Grenoble Alpes

**Intermediate Progress report**

**April 2023**



# Moenjodaro

UNESCO Emergency Mission  
Following Disastrous Rainfall in 2022

## Intermediate Progress report

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April 2023

In August 2022, the Moenjodaro World Heritage Site received disastrous rainfall up to 779.5 mm that seriously affected the archaeological remains. The intensity of heavy rainfall caused severe structural damages, including collapse of walls, developing cavities and holes in structures due to loss of mud and bricks, erosion of slopes and mud *pushta*, weakened the foundations of walls and structures at Moenjodaro Site. Heavy rain also affected the drainage system and the main drain. The main drain around the Main Stupa area choked with silt and other wastes causing accumulation of water into the ruins up to the level of two feet inflicting further damages to the structure.

The site, already fragilized, is in a vulnerable condition and needs urgent intervention with damage assessment and stabilization work to protect these from further decay and future disasters. In the context of limited technical and financial capacity of the staff of the Directorate of Archaeology and Antiquities, Sindh, to handle such a huge disaster and major conservation and restoration work it is required to involve and seek guidance of international experts and technical support from UNESCO. Hence World Heritage Centre strongly encouraged the State Party to apply for International Assistance and mobilized the World Heritage Fund. Directorate of Archaeology and Antiquities, Sindh worked closely with UNESCO Islamabad office to prepare international request for immediate technical and financial support for immediate and long-term conservation of the site under the guidance of international experts and UNESCO.

The engagement of an international conservation expert is intended to ensure that the damage caused to Moenjodaro site by monsoon rainfall is stabilized, and to enhance the emergency response and preparedness capacity of the Directorate of Archaeology and Antiquities and the Government of Sindh, to prevent and mitigate the impact of future natural disasters. This will be achieved through the following specific objectives:

1. A thorough damage assessment of the World Heritage Site, to establish findings and long-term recommendation.
2. Defining adapted measures and launching the stabilization, including immediate repair of damaged sections; training on emergency conservation best practices for site management staff.
3. Capacity building training for relevant staff to address emergency response and preparedness against future natural disasters.
4. Detailed strategy for long-term conservation of both sites, emergency response and preparedness against future natural disasters.
5. Identification of the potential of new knowledge that might result from some damage to be balanced with possible emergency needs including immediate repair and stabilization of affected sections of Moenjodaro as well as trainings and equipment required.

The present report has been prepared by UNESCO expert with revisions made by UNESCO Ahmedabad (Filali-Meknassi Youssef, Menegazzi Cristina and Aziz Jawad), UNESCO WHC (Hayashi Nao) and Moenjodaro Team (Syed Shakir Ali Shah).

Cover picture: January 2023 workshop participants' group picture



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# 1. Detailed assessment by national team (3a, 3b, 4a)

Following the first expert mission, the team in Moenjodaro has started work on preparing plans indicating condition of the structures at the site. Each specific issue was to be covered by a series of plans covering each area of the site: These series of plans were to cover the following issues :

- a) plans indicating existing drainage system : runoff paths and rooms without water outlet.
- b) plans showing the state of conservation of walls
- c) plans showing the state of the capping
- d) plans showing underpinning needs (minor ones)
- e) plans showing pathways and indicating the state of conservation and their potential negative impact (direct / indirect) on some of the structures;

More details on the criteria to be followed for the elaboration of these plans are in 1st mission report, Appendix 3, page 57.

These series of thematic plans prepared by Moenjodaro conservation team have been presented by the Director and other staff, and then discussed at three occasions, through zoom meetings organized on:

- . November 16, 2022
- . December 14, 2022
- . January 4, 2023

## H-R AREA

- Rooms (or courtyards )without water flows outlet
- Paths floors endangering the walls structures (concrete slabs precast slab with slopes leaning towards walls)
- flow of water
- Narrow streets with potentially high flows
- Gullies appeared due to weak drainage system



Example of plan produced by Moenjodaro team after the 1st UNESCO expert mission which were presented and discussed during zoom meetings. Drainage issues at HR area, December 2022.

More examples of plans produced are in appendix 4. The full set of plans produced being available at Moenjodaro conservation office.



Through this process that was suggested by UNESCO Islamabad (see expert ToRs), a lot of progress has been made to reach plans and indications on them that would then be useful to plan works needed with distinguishing four main periods of implementation depending on the level of risk / emergency:

- . what should be part of the emergency plan, to be executed before next monsoon;
- . what will have to be done in year 1 of the longer term recovery plan
- . what will have be done in year 2 of the longer term recovery plan
- . what will have be done in year 3 of the longer term recovery plan

It is to be noted that the third zoom meeting has been the occasion to discuss the second mission program as well as the content and format of the Workshop for which the initial proposal was fine-tuned and agreed upon.

Minutes of these three zoom meetings are in appendix 1, 2 & 3 of the present report.

Though the bulk of the information needed to get a comprehensive picture of the situation was gathered through this process (based on visual observation made in the field, recording manually on site areas plans and then plotted on digital plans), the level of detail required has not been fully obtained, making it necessary to re-discuss the criteria during the training workshop (see chapter 3 of this intermediate report). Thus work on some plans is still necessary for ensuring full accuracy for addressing the need to set all works needed in the proposed time frame (four periods as described above).

## 2. Training workshop report (5a)

As a result of discussions held by the end of the last zoom meeting held on January 4, 2023 with the following participants, an evolution of the initial concept (as proposed in the experts ToR) for the workshop (2 days) was discussed.

Abdul Fateh Shaikh, Culture Tourism, Antiquities and Archives, Ministry of Culture, Sindh

Altaf Aseem, Archeologist, Professor, National expert

Syed Shakir Ali Shah, Archeologist, Director, Moenjodaro Conservation Office

Ali Hyder, Archaeological Engineer, Deputy Director, Moenjodaro Conservation Office

Mr. Naveed Ahmed Sangah, Architect, National Fund for Moenjodaro

Aziz Jawad, UNESCO Ahmedabad

Nao Hayashi, UNESCO WHC, Paris

Thierry Joffroy, Architect, UNESCO expert

The evolution proposed by the UNESCO expert, based on both the findings of the first mission, numerous solicitations for more hands-on and practical activities and also the outcomes of the discussions during the zoom meetings, was to extend the workshop to almost the full duration of his mission (even though that would represent much more preparation and density). This was to allow maximizing interaction and make possible a more comprehensive development with combining lectures, discussions, field visits with observations and exercises, hands on works (demonstrations) and also participatory short and long term planning that would allow full understanding by the team in charge when having to implement the program.

The idea being well received by all participants to the meeting being agreed upon, a new program had been proposed, mostly based on the structure of the first expert mission report (see below), while the participation desired was being left to the national representatives with decision to be shared with Culture Tourism, Antiquities and Archives, Ministry of Culture, Sindh.

<i>Friday 13</i>	<i>Departure from France</i>
<i>Saturday 14</i>	<i>Arrival in Karachi at 10.35</i> <i>Meeting with Ministry of Culture representative</i> <i>. Departure to Moenjodaro</i>
<i>Sunday 15</i>	<i>Morning</i> <i>Overall discussion on first mission content / objectives</i> <i>Identification of specific key issues to be addressed / specific places at the site to be studied</i> <i>Preparation of a more detailed mission program / setting of responsibilities</i> <i>Afternoon:</i> <i>Beginning of workshop / introduction on objectives, methods and program</i> <i>Session 1 : Discussion on quality of raw materials and building materials</i>
<i>Monday 16</i>	<i>Session 2 : Drainage &amp; canals</i>
<i>Tuesday 17</i>	<i>Session 3 : Capping</i>
<i>Wednesday 18</i>	<i>Session 4 : Underpinning</i>
<i>Thursday 19</i>	<i>Session 5: 5.1, Salt / 5.2, Paths</i>
<i>Friday 20</i>	<i>Rest</i>
<i>Saturday 21</i>	<i>Session 6: Study of places "at risk" + Stupa: discussions on works</i>
<i>Sunday 22</i>	<i>Session 7 : Overall planning / Works – Research- training - publications</i>



emphasize much on that. As a result, there might have had insufficient attention given to this issue of quality of building materials while, having to take stock of potential for repeated and increased solicitation / threats due to climate change, this now appears to be a paramount issue.

Actually, there exists much evidence that there are substantial differences in their capacity to resist to regular stresses as even at same locations, the state of conservation is very different. The case of the burnt bricks is particularly illustrating that with in the presence of salts bricks in the same course can be in perfect state while another besides it is almost fully disintegrated.



*One of the examples discussed: the variety of quality of burnt bricks is very visible on this wall at DKG area, very good state at the base, almost fully disintegrated in the middle, acceptable at the top*

The issue of soil selection for mud bricks making and mortar to be used for masonry repair and capping, also seems to be underestimated, as there is, probably for several years now (as there are signs in the eroded wall capping) the use of soils that contain quite a huge amount of vegetal matters (plant roots).

This calls for launching a process for re-installing a more systematic process for the quality of the materials being used at Moenjodaro, both for the earth and for the burnt bricks:

### **Decisions on the evolution of the practices / techniques**

Soil for bricks and mortar:

1. Make a systematic test for detecting salt presence (with rejecting if positive)
2. Make a systematic test on particles size distribution content;
3. Adapt mixes accordingly (addition of sand for bricks and mortar / addition of straw for plaster);
4. Adopt lime as an additive in the mortar for underpinning work (using traditional recipe within volume: 1 Lime, 2 Sand; 4 Soil);

Burnt bricks:

- 1 Make a drastic selection of bricks to be used for underpinning, aspect, clear sound, prefer ancient brick that have proved their capacity;

### **Preparation for the future:**

1. Continue to identify potential soil quarries, test soils (against salt) and try to secure the availability;

2. Prepare soil stabilization samples with using locally produced gypsum and lime, both traditional and industrial types) and test them through watering (by watering can), capillarity and immersion tests so as to get some first knowledge on their effect on the mechanical properties of products obtained and their behavior in humid state. Proportions to be tested: 5, 7.5 and 10 %. Later on, when press be available, compressive strength tests will be carried out.
3. Identify brick manufactures around Moenjodaro, in the view to identify producers that get best results (might be known within the local population);
4. Explore with them the possibility to prepare special orders for improved quality (mostly capillarity / salt resistance to be tested);
5. Explore machine producers in Pakistan and the evolution proposed by some of them that could help in improving burnt bricks quality (to be checked / tested if possible);
6. Explore the possibility to fabricate special burnt bricks (and possibly pipes) at the site.

As already suggested in the first mission report, that will require acquisition of specific equipment that needs to be identified (and also where to acquire it) to reinforce the lab capacities, with also taking into account the need to train additional young professional that will be able to take other the works already been done at MCO laboratory.

## 2.2. Contents and results of session 2: Drainage and canals

**Issues presented for discussion** (extracts from 1<sup>st</sup> expert mission report)

The heavy rains that have affected Mohenjodaro by the end of August 2022 have resulted in numerous and sometimes large flows of rainwater, a situation that had not been taken into account by previous studies, most of them dating back from the last century. Major difference with what had been observed in the past is that with both the repetition and intensity of the rains for 10 days, the absorption capacity of both wall capping and floors has been reduced or even eliminated due to their level of saturation.

In the Conservation Manual (Treatment descriptions – 13), the wall capping is presented as: *“The aim of the wall capping is to provide a protective covering over the wall that will minimize the flow of rainwater into the wall from the top. Wall caps have been used for more than 30 years and have proven effective at providing important protection against penetrating rain which would ultimately destabilize the walls. ...”* This is absolutely right, but what is also the effect of these caps is absorption of a good part of rain water. But when the cap is saturated the water then flows down the wall and continues on the ground / floor.

Concerning the floors, there are several sub-chapters in the conservation manual (treatment descriptions – 15, 16 & 17) including sloping, levelling and reinforcement of gullies, all described as ways of keeping reasonable run-off and transporting it to safe discharge areas. It is also indicated that in some cases, terracing, ponding and shallow trenching could be good solutions in case of little collection surfaces.

The use of drainage pipes is not so much encouraged: *“The installation of pipes through the walls should only be carried it as a last resort for reducing serious problems of run-off accumulation in closed areas. Very careful consideration should be given before disturbing ancient walls, and all alternatives should be explored. ...”* The manual also suggests the use of drains, as being “important character-defining features at Moenjodaro” (Treatment descriptions – 22), and further recommends the preparation of comprehensive drainage plan (Maintenance – 4).

Though these recommendations took into account what had been considered at that time as being the worst rainy season at Moenjodaro (298 mm between July and September 1994) this was far from what was experienced last August (779.5 mm in 10 days).

As a result, the capacity of the drainage system in place, even if actually very well mastered (very high know-how on that, with very fine work observed) has been seriously challenged leading to most of the major damages observed, resulting either from stagnant water inside some of the rooms (some of them have no water outlet system and had required pumping of large amounts of water), formation of huge flows of water at the basis of some walls and also floor/ground erosions (gullies) that, at some points, have led to damage walls.

Gaps in the backfilling under some room's floors have also led to the formation of depressions with at times the formation of underground flows of water.



*Failure of drainage system at SD area © N. A. Sangha:*



*Temple at HR area, with traces of high water level*



*Undermining of wall by run-off, SD area © N. A. Sangha*



*Ancient drainage systems damaged, south of SD area*

One should note that the system used at Moenjodaro for the treatment of the floors (sundried mud bricks laid on a layer of sand) though giving satisfaction for draining water flows in regular raining circumstances, has proved ineffective (if not dangerous) when run-off is higher, infiltrates under the brick layer, resulting in washing of the sand layer and further, acceleration of the erosion process of gully formation.



*Gaps left by eroded sand under mud brick floor SV area Pushta protection affected by water infiltration HR area*

Besides that, this system is allowing water infiltration through the bricks and then through the layer of sand down to the original fabric. The resulting issue is that this humidity is like trapped under this layer of sand with the only potential of being evaporated through wall structures, at times above ground level, but also when structures are forming terraces (more specifically the case of the stupa zone, but not only), and as such, increasing the potential of crystallisation of salts on their surfaces (see next chapter).



*Traces of high humidity content under floor SD area Traces of high humidity on retaining wall. SD area*

At a larger scale, it was noted that the overall drainage system sometimes involves collection of rainwater from large areas and instead of driving the run-off far from the archaeological remains, drives it inside narrow streets. This is the case more specifically at DK area where the large street at the eastern side drives water towards south but as it is blocked by archaeological debris mounds turns right inside the old city fabric, to finally be drained towards the western canal (see picture below with arrows indicating flows directions. But there are many other similar situations where high run-off is guided towards archaeological remains instead of “to safe discharge areas”.



*The levelling of the large street east of DK south area drives runoff towards the built structures at its western side*

## Visits

To illustrate these issues, the site visits covered HR and DK South areas to study specific cases. Some known places were used as “exercises” with first trying to have the best understanding of what had happened, and second look for solutions with when relevant, reflecting on a temporary solution before either means (to avoid having too much to do in a short period of time) or specific documentation be gathered so as to make sure that decisions would be well informed, based on precise data.



*Two specific cases that were discussed in HR area.*

*Left: need to open canal from temple room; In-depth observation has led to understand that there was a need to consider both western and upper zones (above temple itself) to ensure that less runoff would be driven to temple. It was also decided that a shallow drain be installed at the eastern side,*

*Right: depression in a courtyard. Alerted by Ali Gul, foreman, this huge depression in the ground was studied. The observation of the topography led to deciding that a drainage pit (the only possible solution) should be provided. As a follow-up, a sketch and a rate analysis sheet were prepared.*



*Inspection of circular canal – northern zone.*

## Decisions on the evolution of the practices / techniques

1. Replace the sand layer of the pavement technique by mud mortar
2. Use of drainage pits at the center of the rooms where it appears impossible to install exhaust pipes
3. Use of wells for drainage when existing / possible (HR area)
4. Modify pavement slopes when they drive runoff towards wall basis (L area)



5. Add mud bricks pavement at the sides of concrete slab path to avoid depressions (and stagnation of water) at the side of the wall basis (HR area)
6. For each area / sub area, start with treating main drains and progress upward in the collecting zones. Exhaust pipes in rooms come last

### **Priority areas for the next 6 months**

1. SD area :
  - a. southern side: the two main need to be repaired + T connection of two canals to be improved with taking into account that this is located in the middle of a visitor's path
  - b. Change pavement around stupa (up to barrier)
  - c. Northern zone (series of rooms under stupa)
2. L Area :
  - a. Revision of path slopes (to be done simultaneously with underpinning)
3. HR area
  - a. Revise drainage slopes at south west of the bath to protect bath's canal structure
  - b. Repair bridge base (fill gaps of the concrete structure after cleaning of altered parts)
  - c. Install slopes both side of concrete path (north-south street at western side) using brick pavement technique
  - d. Dig trench south of "temple" to re-establish proper drainage. Increase floor level of temple (if necessary). Revise drainage above temple and at its eastern side
  - e. Dig 2 drainage pits in the two large room / space (those in depression area) indicated by site supervisors
4. SV Area (Room with well at floor level)
  - a. Repair well masonry from inside (replacing altered brick/mortar)
  - b. And renew completely floor pavement with new solution (brick on the edge laid in mud mortar with slopes towards well), that will include backfilling of gullies and its compaction.
5. DK south
  - a. Change drainage slope at south east (2 rooms, as indicated on plan)
  - b. Change drainage slope at the southern side of the concrete path (western side) with providing connection to canal from DKG North.

### **Preparation for the future:**

1. Prepare a new rate analysis form for Drainage pits
2. Prepare plan for the rehabilitation of the circular drain (locating / quantifying works)
3. Prepare a plan indicating drainage slopes and location of temporary pools on the overall site (to be undertaken during next moonsoon)
4. Explore the pertinence of superficial drains from all areas towards circular drainage canal (to be undertaken during next monsoon, after above point)
5. Prepare a plan for the proposed drainage pipes system in DK south area : number of pipes, where, size of pipes (bill of quantity)
6. Examine each situation and revise drainage plan to ensure better repartition of water flows (exploration mainly at the edges of each area)
7. Elaborate a strategic plan to gradually cover the overall site.

## 2.3. Contents and results of session 3 - Capping

### Issues presented for discussion (1<sup>st</sup> mission report)

This session on capping was introduced using two different resources.

First a presentation was made of a case study in Egypt that of earthen structures excavated near the Saqqara pyramid, near Cairo. Actually this northern part of Egypt is also prone to climate change effect with both increase in intensity and frequency of heavy rains. This has brought about an increase in the collection of water at the top of the earthen walls and as a result higher concentrations at the edges and formation of large gullies.

Observing the variety of solutions that had been developed in the past at several individual sites it was observed that rounded shapes were behaving better, allowing for better repartition of the flows of water and so avoiding formation of gullies.

As a result adaptation to climate change for intervention at the pilot site chosen in the area has adopted these rounded shapes.



*Left: Typical degradation process (formation of gullies) at Saqqara  
Right : proposed solution for capping (Pepy 1st site)*

This presentation was followed by revising the indications in the conservation manuals while also using some of the recent reports of works undertaken. It was realised that rounded shapes were already quoted as a best solution, though had not been set as compulsory, thus had not been applied for many years. When looking at new risks linked to climate change, it was decided that the adoption of rounded shape of wall capping should now be the rule.

### Visits / field work

It was organized in two steps.

First, a visit in DK south and DK North areas led to a clearer definition of the level of priorities for renewing capping with three criteria to be adopted when further fine-tuning the condition survey plans:

- . no capping at all
- . remains of capping (less than 10 cm thick)
- . sufficient capping level (between 10-20 cm thick).

Second was devoted to the preparation of a sample of capping with a rounded shape. It was organised at DK areas entrance where brick making is on-going. The team did show capacity to easily undertake this type of work, while the appearance of cracks in the mortar led to sensitize to the need to take care to the quality of the mix used which do need addition of sand, long chopped straw for the core of the shape and short chopped straw for the final plastering layer.



*Rounded shape capping sample being prepared during field session*

## **Decisions on the evolution of the techniques**

1. Use the most elaborated version of the procedure as indicated in the Conservation manual (p.IX-13) that means:
  - a. Capping to be done with mud bricks masonry using mud mortar;
  - b. Ensuring the creating of a rounded finish at the top (to be prepared with bricks and mortar with central height depending upon width of wall);
  - c. Make best use of existing remains to be removed with reusing mud brick pieces for round shape and small pieces for the preparation of mortar;
2. For better protection and longer duration,
  - a. Add two brick layers (instead of one only) above burnt bricks before rounded shape;
  - b. First prepare the round shape with bricks and then add first mortar / plaster layer to form the final shape (half inch should be left at the sides for flush finishing of final layer)
  - c. Apply last course of mud plaster which will finish flush with the bricks faces;
3. Point 2-C potentially applies to a more regular maintenance need when what is needed is only replacing a mud plaster when that has been washed.
4. Adaptation of this method is done according to each situation. High of rounded shape. Potentially, more layers of mud bricks are installed on a side of wall so as to reach same level on the whole wall. Stepped bricks can also be used when addressing an original stepped structure.
5. When top of wall reaches a platform, a combination of half capping and flooring technique (bricks laid on the edge on mud mortar) is adopted presenting a continuity;
6. An additional possible combination is with introducing shallow drain between the half capping and the flooring system of the top surface / room

## **Priority areas for the next 6 months**

1. SD area :
  - a. Top part (around stupa platform)
  - b. North and western zones
  - c. Special attention above narrow pathway, with reconstruction of collapsed wall and putting into practice decision 4 (see above) with ensuring that shallow

drain finds a continuity on the narrow platform and at its north and then in the pathway down to the shallow drain at the side of the concrete path already planned.

2. DKG south :

- a. All walls with priority to those that do not have any remain of capping.
- b. Select walls with more potential for reducing water flows in the main water flow (the one passing by well preserved house).
- c. Select walls which needs repairs at their top so that those can be done simultaneously;

**Preparation for the future :**

1. Revise rate analysis form for capping to adapt to the new specifications;
2. Evaluate work to be done for each area and for the overall site to be introduced in 3-4 year Sindh Gvt. / UNESCO project;
3. Setting priorities and elaborating a strategic plan (in 3 to 4 year schedule) to gradually cover the overall site with first adding capping where not existing and then replacement of old capping, starting with the most affected ones. Priorities have been defined as :
  - Priority 1: no capping at all
  - Priority 2: remains of capping (less than 10 cm thick)
  - Priority 3: sufficient capping level (10-20 cm thick).

**2.4. Contents and results of session 4: walls / underpinning**

**Issues presented for discussion (1<sup>st</sup> mission report)**

A series of 21 pictures was presented for discussion. It included cases illustrating the basic principles of the phenomenon affecting the structures at the site followed by how the process decline depending on the circumstances in which they occur and the specificities of the structures themselves. Evidence of links between the wall decay processes and the presence of salts was also touched upon.



*Two column types of wall (L and DKG areas) illustrating well the typical collapse process starting from the base*



*Wall collapses where salt attack has played a strong role at DKG (left) and HR (right) areas.*



*Two stages of the process of separation between the new and the old parts of walls, DKG area.*



*Damp proof course at DKG partly efficient*

*Concrete layer between the two last brick courses at HR*



*Pressure against walls by backfilling of platforms / rooms floors, DKG area (left) and SD area (right)*

Discussion after the presentation led to the idea that the visit / field part of the session should be focused on the issue of underpinning that raises more technical approaches.

### **Visits / field work**

To address the priority discussed (see above), it was decided that the site visit should be organized at DKG south where numerous cases of wall basis decay can be observed, some affecting very high structures which require specific care. That has led to discuss what would be the best methodology of intervention with giving specific attention to security measures prior to intervention. That led to recommend:

- . provision of security equipment for the workers : helmets, security shoes;
- . detailed observation / understanding of the weaknesses and risks linked (more specifically when wall base is attacked on both sides);
- . definition of an intervention strategy, starting with the easiest part to be treated (often at the ends of the “destructive furrow” and further possibly portion by portion);
- . strutting with wooden structures if felt necessary for safety;
- . strutting with truck jack(s);
- . cleaning the gap to be treated (if presence of salt, possibly applying mud mortar for absorption);
- . possibly removing some bricks or parts of bricks so as to be able to accommodate full size new bricks (half or full / stretcher or header);
- . intervention with ensuring proper bonding / proper filling with mortar to avoid evaporation inside the wall and thus salt accumulation.



*Wall seriously affected where most of the field discussion occurred (DKG south area)*

Another potential practice has been discussed and approved, that of temporary dry masonry supporting structure, leading to a demonstration being made at one of the most affected wall

in DKG area (see pictures below). It was however concluded that such measures should not be kept for long periods as on the long run this solution may favor crystallization of salts between the original and dry masonry.



*Demonstration of wall base treated temporarily with dry brick wall (without mortar)*

### **Decisions on the evolution of the techniques**

1. Make sure there is a full understanding of the causes, circumstances and processes of each specific decay observed (looking at the situation at large, including the surroundings, and also when it occurred) so that, in addition to repair, these causes can be eliminated to ensure durability
2. Security measures : when needed install struts against wall and possibly also truck jacks (with planks for the junctions with base and top); helmets and security shoes for the workers to be provided;
3. Preparation is paramount. That involves :
  - a. cleaning of debris;
  - b. dismantling of parts that have lost too much stability and bricks showing alteration;
  - c. sorting out bricks that can be re-used, wash them if traces of salt;
  - d. removing debris, more specifically when they contain salt;
  - e. when high concentration of salt is observed on the wall face apply plaster (or built a temporary mud brick wall when side of wall has collapsed) to absorb it – remove it when salt appears at its surface
  - f. prepare a good bearing surface at the bottom (that might also concern top) to ensure stability of the repair;
  - g. identify zones / bricks in the original wall that are weak that can be removed on priority to create proper bonding (possibility to introduce headers).
4. Choice of mortar:
  - a. For wall faces, mud mortar is sufficient
  - b. For wall basis, potentially exposed to dampness and water (flows and stagnation) use improved mortar, composed with: 1 lime putty (paste prepared on site from quicklime), 2 river sand and 4 soil.
5. Repair should follow the following rules:
  - a. Work slowly : not more than 3 layers of bricks laid every day so as to ensure that there is minimum settlement of the new masonry and thus best liaison with the old one
  - b. Make sure that the gap between old and new walls is well filled, potentially using brick pieces to avoid formation of gaps (shrinkage);

- c. Insert as many headers as possible. If this is not possible, insert twisted iron bars (need to drill wall with strong bits) every 3 layers and lay them in cement sand mortar;
  - d. When the repair reaches the top of the gap, wait for the new masonry to settle, (at least three days) before filling the last mortar joint. The mortar joint is to be hammered so as to get maximum compaction and best connection between the repair and the upper part of the wall;
7. Temporary measures:
    - a. Temporary measures with piles of dry burnt bricks masonry is to be applied when work on a structure in danger cannot be treated immediately.
  8. Strutting is a possible long term solution (metal systems exists at the site that can be used as examples)
  9. Buttresses / Pushta are also potential solutions, more specifically when underpinning repairing appears very uneasy. Buttresses may also apply when archaeological plans indicate the presence of such structures (case of room 69/12 in block 1 in DKg south)

### **Priority areas for the next 6 months**

1. SD area :
  - a. Exit canal of baths
  - b. Wall at eastern side of main passage (divinity street)
  - c. Stupa
2. L. Area
  - a. Wall along the path (work to be undertaken while changing path slopes);
  - b. Well inside room (section C, block 4, room 85) – also linked to drainage plan
3. HR Area :
  - a. North south street (third street) at western side (to be undertaken together with change to the drainage)
4. VS Area:
  - Well (with connection to drainage /pathing)
5. DK North
  - a. House at the north end of west street (block 17 house IV, room 36)
  - b. Cleaning of canal at the south end of the same west street and revision pf backfilling before the underpinning
6. DK South
  - a. Well preserved house
  - b. room 18 (western wall ), House N°2 , Block 8
  - c. room 17, House 3, block 2 (shoring)
  - d. rooms 22 and 15, house 2, block 8
  - e. room 61 and 47, block 1
  - f. House without doors : Block 7, House VIII, Room 58, 60 and 61
  - g. Room 69/12 in block 1
  - h. Room under path on the eastern side (linked with drainage plan)
  - i. ... to be completed using the more elaborated survey to be prepared (plans, see hereunder)

### **Preparation for the future:**

1. Revise existing underpinning / condition plan for each area with bringing more details according to level of risk with classifying under three categories:



- a. High level of risk (major gaps in the structure, high walls,...), thus to be treated before the 2023 monsoon or first year of UNESCO project
  - b. Medium level of risk , to be treated within the next two years
  - c. Low level of risk (need only regular inspection before potential treatment after 3 years)
  - d. Houses / structures where there are special issues (concrete slabs, concrete tie beam, special masonry patterns,... , ) which makes it difficult to be classified without more investigations..
2. Prepare bill of quantity for all categories / area in view of establishing long term plan
    - a. Provide data on quantities
    - b. Provide data on time needed (Nb. of working days / team )
3. For each situation for category a, evaluate the urgency and feasibility before the 2023 monsoon with the following criteria:
    - a. Duration of the work
    - b. Cost
    - c. Availability of the materials
    - d. Potential for establishing temporary measures (strutting, dry brick masonry support, ...)
  4. Plan for research on mortar tests so as to fine-tune recipes for lower levels of masonry, potentially exposed to damp and water flows.

## **2.5. Contents and results of session 5.1: Salts effect / mitigation**

### **Issues presented for discussion / visits**

Issues of conservation linked with the presence of salts is extremely present. This is not new as it had been a concern from very early times of excavations with quite fast after the structures was unearthed problems of conservation of the fabric (mortar and burnt bricks had appeared. After the presentation of a series of slides covering the variety of cases observed, including some illustrating the potential origin / source of the salts, discussion occurred and points of view were shared.

The site visit was the occasion to better share the observation that salt is very much present in many places, with the identification of place where pools form during the monsoon, favouring the presence of salts (and salt crusts) at the ground surface. And with wind blowing strongly, it was also identified that wind could participate in the presence of salts in the structure, which could explain why salt is also present at some tops of the walls.

It was recognised that with climate change and potentially more rainy events, existing processes observed may increase in their frequency. On another hand, the potential for salts being washed away from the site by runoff water was also recognised, though requiring better understanding of the processes, thus more observations, more specifically during monsoon (and during heavy rains to better observe runoffs).

As a result, the issue of salt was collectively defined as one of the major issue, which resulted in the need to go further than what had been done in the past with launching a salt battle!

### **Decisions on the evolution of the techniques**

1. Make sure that all raw and building material brought to the site are free from salt presence (see building and raw materials conclusions);
2. Be systematic in the need to remove salt infected matters and bring it far from the site (Indus river side, get authorization if needed). That includes :

- a. Collecting dust when brushing walls (already done);
  - b. Collecting dust when daily cleaning paths / rooms / streets;
  - c. Collecting debris when preparing for underpinning works;
  - d. Collecting old matters when replacement of room or street floors is decided;
3. Be more systematic in the application of mud slurry;

#### **Priority areas for the next 6 months**

1. Most affected areas in SD, DKg, HR and VS (to be identified more precisely)
2. All areas where other works will be carried out (drainage / underpinning ) will have their surrounding walls/ floors being “treated” (see above);
3. Prepare some sample tests (for a thorough comparative observation later) on northern walls along major water runoff in DKg area with treating only the base of the walls (up to 1m) with light slurry, thick slurry and mud plaster (specifications in conservation manual p. IX-8);
4. Undertake test of treatment against salts on two walls (one in HR and one in VS) which are highly infested with applying a thick coat of mud plaster. (salt absorption test).

#### **Preparation for the future :**

1. Identify most affected zones in each area; evaluate potential relation with a nearby source (debris pit, pools, infected grounds, ...); map these information on a specific plan.
2. Revise (or add ?) rate analysis form to cover all types of removal of debris;
3. Evaluate work to be done in each zone to organize a mechanical superficial cleaning of salty surface soil and get quotations for it;
4. Review UNESCO experts reports to check what had been already proposed earlier to explore the potential of some plants to absorb some of the salt and thus to plan or favor their development at the site;
5. Prepare for a long term research protocol for getting more precise data on the behavior of existing solutions (slurries of various thickness / plasters of various compositions). That includes identification of specific walls where that can be done with variety of orientations / surrounding conditions;
6. In relation with the above, undertake research within archaeological reports so as to identify potential evidence of plasters which could have been the solution used in the past (historic occupation) to reduce effect of salt (ref. Article by Dr. M. Jansen)<sup>2</sup>. Exploration should also be made at other similar sites so as to enlarge references within the larger scope of the Harappan culture. (possibly organize an expert gathering to discuss the issue)

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<sup>2</sup> “... it would bring back the original surface and colour to the walls which, as we know, were plastered with clay some 4,500 years ago”. In: JANSEN, Michael, 2003. « Mohenjo-Daro - Pakistan, The problem of Adobe & Brick Conservation ». In : *Pre-print of papers, 9th international conference on the study and conservation of earthen architecture, Terra 2003*. Tehran : Iranian Cultural Heritage Organisation. p. 309-318.

To be elaborated in relation with the establishment of drainage plans (including overall site plan) as described at point 2.2 so as to identify potential links:

7. Identify zones where there is stagnant water (pool like) during monsoon and evaluate work to be done to eliminate them (opening superficial drainage ways for ensuring continuity of runoff);
8. Get quotations for the cleaning of the circular drainage canal;
9. Setting priorities and elaborating a strategic plan (in 3 to 4 year schedule) to gradually cover the overall site.

## 2.6. Contents and results of session 5.2: Paths

**Issues presented for discussion** (extracted from 1<sup>st</sup> mission report)

The session on paths has been introduced with a short series of pictures (17) showing main cases that had been observed during the first UNESCO expert mission, but also some of the on-going works. This was just a quick introduction as it was felt that more potential for understanding issues on paths would be at the site itself.

### Visits / field work

To discuss the condition of paths, the visit was started at SD area, then going towards L and then HR area. The final point of interest was at the southern end of DKG south where works were on going, allowing for discussing the advantage of using rammed earth technique for ensuring more stability of the paths on the long term.



*Discussion on the negative impact of path on a wall at L area*



*Observation of the decay of a concrete slab path and taking stock of its dangerousness, leading to the recommendation of closing this path to the public.*



*Demonstration of the rammed earth technique adapted to the construction of “high resistant shoulders” for ensuring long term durability of all types of paths (avoiding erosion at the sides), path under repair at the south east of DKG south area.*

## **Decisions on the evolution of the techniques**

1. Established pathways where there are strong compacted grounds (avoid archaeological debris pits);
2. Avoid sloped terrain both with lateral or longitudinal consideration to minimize risks of creating large flows of water and minimizing preparation work and side buttresses;
3. Carefully identify zones where water runoffs / gullies are existing; evaluate water flows levels to decide size / number of pipes needed and potentially prepare a design for the required “bridge” under the path;
4. Ensure that paths slopes do not drive runoffs towards archaeological structures;
5. Prefer burnt brick solution to precast concrete slabs solutions ; abandon in-situ cast concrete solutions;
6. To ensure durability of paths:
  - a. Make a drastic selection of burnt brick producers for ensuring best quality of the bricks ; In case bricks of lesser quality are identified, reject them;
  - b. Ensure that both sides of paths be treated with sloped and well compacted soil to serve as a buttressing asset and to avoid erosion;

## **Priority areas for the next 6 months**

1. Paths may not be seen as first priority, if not to ensure security of visitors at the most visited areas;
2. Thus, SD, DKg and L areas are the main priority zones;
3. Paths passing south of L area needing further evaluation / studies. They should be closed to public (still possible to access to HR area from northern path at L);
4. Bridge like zones (over gullies) may also be treated first;
5. Portions where there is a clear link with drainage issues.

## **Preparation for the future:**

1. Revise “rate analysis sheet” for paths (N° 10) to adapt to the new specifications;
2. Use the plans prepared to evaluate work to be done for each area and for the overall site to be introduced in 3-4 year Sindh Gvt. / UNESCO project
3. Setting priorities and elaborating a strategic plan (in 3 to 4 year schedule) to gradually cover the overall site.

## 2.7. Contents and results of session 6: Special cases

During the first UNESCO Expert mission several very special conservation cases were identified which were discussed during this session (6). Those comprised:

- . Bath canal at SD area;
- . Sundried earth brick stupa at SD area;
- . Well preserved house at DKg south;
- . Baths canal in HR area (which were already discussed during the “Drainage site visit”).

To that first list an additional place was added: the “no name” street located on the southern side of the little hill north west of HR area as well as the no door house at DKG south.

For each of these cases, a site visit was paid with the aim of :

1. Getting an understanding of what were the causes of the pathologies observed;
2. Making sure that all possible “domino effect be explored;
3. Discussing the urgency of undertaking repairs;
4. Reflecting on the information available, if sufficient or not for decision making;
5. Making concrete proposal(s) either for repair or for a temporary measure (before conditions required for the repair be set).

### Bath canal at SD area



The inspection made by the workshop participants revealed that the cause of decay was not the canal itself (the canal from the bath was obstructed, that was probably the cause of decays in the bath pool walls, already repaired). The cause was rather the water runoff which after careful observation of slopes started to form on the other side of the pool itself (more than 60 m away).

That established, the restoration was discussed but which led to a very specific question that of the reconstruction of a corbelled vault, which would not be too difficult, but in the case of this canal which is forming a turn (about 110°). What could be the bounding for that? As

no response could be given, it was suggested that an enquiry be made (reports, pictures, if needed preparation of models, small size and full size) before engaging in the restoration. In that respect it was regretted that debris from the vault would not have been kept as they would probably have been paramount in understanding the bonding adopted for this special structure. Part of those may also had the possibility to be reused in the restoration process. It was thus decided that what should be done as part of the emergency plan would be to:

- . Restrict access to that area;
- . Dismantle overhanging
- . Dismantle a small portion of wall blocking water flow and install a temporary shallow drain that would guide runoff far from the canal itself.

In the meantime exploration of existing documentation should be launched and reflection on design started.

### **Baths canal at HR area :**



Similarly to what has been observed for the bath canal at SD area, the diagnosis at HR area for the two covered canal concerned was that the destruction (partial) was not linked to the presence of the canal, but being the result of water runoff too close to the external wall.

Risk of further collapse are now quite limited and as there are many other works to be done elsewhere, it was decided that rather than launching a restoration process, a preventative measure should be taken, that of releveling the ground at the side of the canal so as to make sure that water runoff would be at least 3 m away on the south side.

### **Sundried bricks stupa**

During the first expert mission, only a quick look was given at the stupa structure. What had been quickly discussed was that it would probably be possible to just rebuild the fallen parts (protective layer above geotextile).

During the visit, a much more detailed inspection was carried out by the expert who

managed to climb up and go round the stupa base. That inspection led to the understanding of a much more difficult situation with several cracks showing that in addition to fallen parts, other remaining ones were not very stable. Moreover cracks at the top and at the sides would 1) offer the possibility to let rainwater penetrate in between the external protective layer and the geotextile and 2) make it difficult to find a strong base on which reconstruction of the protective layer be made.



As the presence of such situation was also visible inside the stupa (a more accessible place) the discussion on “what to do” was organised there. It was commonly agreed that the best solution would be to remove the protective coat and the debris and rebuilt them. On the other hand it was suggested that the protective geotextile be left in place.

Concerning the reconstruction, the masons were asked their opinion. Actually one of them participated in the process some 30 years ago and was fully able to explain how it had been done, making everyone confident that he could do that work (and train younger masons) without needing too much guidance.

As the quality of soil that had been used appears to be high, it was also decided that the bricks and debris be re-used for the fabrication of new bricks as well as for the mortar and plaster.

Finally it was also agreed upon that the reconstruction process should follow similar specifications as the one for underpinning, with slow progress of the work to be established (no more than three layers of bricks everyday) for ensuring best connection between the old and new part (through avoiding large settlements due to mortar shrinkage and compaction).



*Inside the stupa, much more accessible than its outside elevation*

### **Well preserved house (DKG south)**



The well preserved house has been seriously affected during the August 2022 rains. There are several walls that have suffered erosion at their base, on the two sides (mainly inside partition walls). The inspection has revealed that some of the walls have their stability endangered (see picture above).

Thus, the recommendations made for underpinning fully apply here (see page 21), to be implemented with maximum care for ensuring safety of the workers and structures.



## House without door (DKG south)



Current situation found at House with no door:

Two rooms without openings in this house are filled with debris on about 1,5 m high. The southern room has the top of this debris leaning towards west while the northern room is leaning towards east. And a tree is growing in the southern room. The slopes of the debris are guiding rain water towards walls and as such there are degradations on the opposite face of the walls concerned.

Suggestions made for emergency measures:

Remove tree in southern room;

Collect old bricks which are in a good state at the surface of the debris and keep them (possibly after being washed – of salt is visible) for restoration purposes in the future;

Carefully check partition wall and more specifically its base, and (hopefully that will be possible) install a dry underpinning solution on its northern side;

Level the debris in the two rooms so as to have a slope from the 4 sides towards the center of the room (collection of rainwater in the center);

On the west side (of these two rooms), remove debris above the two pushta buttresses, and reopen water channel from the small south room to northern room and relevel the overall so that water cannot stay at the base of the two pushta buttresses.

This house will need further consideration, the idea for this year is to minimize risks as a full cleaning of the rooms would take too much time this year. Only next year, time will potentially allow to totally remove all the debris while also underpinning work will be needed on the west and east walls and pipes will need to be installed.

This house has been one of the first work being done by Moenjodaro conservation team (see picture next page).



### **No name street**

No name street has been temporarily given to that street as it has never received any name ! It is also in a part of SD area which could not be given sufficient attention these last years. As a result of limited attention and no monitoring some erosion has taken place that has probably much increased during the heavy rains of august 2022. As it is a typical situation which do need to be addressed in emergency, it was also taken as one the studied case study.



As it can be seen on the picture above (p. 33), the weakness here has probably its origin from a base insufficiently compacted for the shallow drain that was rightly installed to properly drain this sloppy street. That has led to infiltration and erosion under this pavement which now evolves towards presenting risks for the walls at its both sides.

This diagnosis has led to recommend that the path be removed and redone making sure that its base be seriously compacted and to lay the burnt brick shallow drain on mud mortar rather than on sand.

## **Overall lessons learnt during session 6 : special cases**

**Main origin of problems : Water**, though on various forms :

- . direct exposure (rain)
- . water flows (runoff)
- . humidity – possibly coming from far

Main aggravating factor : presence of salt

**In terms of methodological approach to understanding / intervention :**

*In addition to existing suggestions in the conservation manual.*

- . Look at decay but step back and consider the overall environment; check on the sides, behind;
- . While cleaning debris of a fallen structure, make sure that bricks and, even more important, specific elements (cut bricks or specially designed bricks) be kept as a source of information and also for reuse in the restauration;
- . Try to understand what has happened; crosscheck with observations at other similar places.
- . Before thinking of repair think on risk mitigation > preventive measures (capping? drainage ? other ?
- . Think of the best adapted method for repairing > regular or special specification?
- . Identify potential reference material (archaeological reports / intervention reports, specifications that can guide decision (values, special issues to be revealed) to make sure that your intervention makes sense (technically / aspect - authenticity);
- . Install safety measures before intervention
- . Fencing (public) if needed;
- . Undertake works with carefully documenting (before, during, after)
- . Define / address maintenance needs / potential frequency
- . Monitor (best period rainy season)

## 2.8. Contents and results of session 7: Overall planning for short and long term

### 2.8.1. Plan for urgent interventions (to be undertaken before 2023 monsoon)

To discuss the feasibility of the emergency plan, Ali Hyder and Aijaz Ali Mashori, did take a full day off the workshop to:

- Adjust existing "rate analysis" sheets to adapt to the proposed evolutions of the technical specifications (capping, paths, flooring, etc.);
- Prepare a new "rate analysis" sheet for the construction of drainage pits;
- Prepare an updated bill of quantity (very detailed pivot table excel file) for all types of works, based on the indications plotted on the plans prepared;
- Prepare a specific bill of quantity for the works that had been listed during the workshop as first priority, to be inserted in emergency plan.

As a result, the table hereunder could be presented during the first part of session 7. (full size table is in appendix 6)

REQUISITION FOR SIX MONTHS WORK AT MOHENJODARO 2023																	
S.#	Items of work	Unit	Qty	Mason @ RS 1500/P/day	Labour @ RS950/ Poly	Donkeys @ Rs950/- p/day	Sweat earth	Sandred Bricks 11" x 5 1/2" x 2 1/4"	Burnt Bricks special size 11" x 5 1/2" x 2 1/4"	Burnt Bricks 9" x 4 1/2" x 3 1/2"	Husk/strew in Mud	Tracer rules No. of trip @ Rs.2000/- p each trip	WOL for sweet water etc.	Geo textile	Gravel/Flint brick blast	Miscellaneous /Unforeseen/Solih m. etc.	Total
				Nos.	Nos.	Nos.	P.100 Cft	P.1000 Nos.	1000 Nos.	P.1000 Nos.	P.Md:	No.of trip	liter	sq. meter	P.100 Cft	L.S	
	Rate			1500	950	950	2000	12000	28000	12000	1000	2000	231	150	4500		0
1	Under pinning to the decay and undermined walls with burnt bricks (both old and new) laid in mud mortar. The old salt saturated bricks likely to be reused for the purpose should be free from salt and it can easily be got done by dipping them in canal water for such a time till it is confirmed that no salt lies in	P.100 Cft	2460	55,35	334,56	98,4	861	0	29520	0	0	0	57	0	0	0	0
	<b>Total</b>			<b>83025</b>	<b>317832</b>	<b>93480</b>	<b>17220</b>	<b>0</b>	<b>826560</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>13167</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1 351 284,00</b>
2	Providing mud capping of the top of the walls with sundried bricks laid in two layers.in convex shape as advised by UNESCO expert on visit in oct: 20/22	P.100 Sft	39800	199	927,34	0	15920	537300	0	0	1500	0	398	0	0	0	0
	<b>Total</b>			<b>298500</b>	<b>880973</b>	<b>0</b>	<b>318400</b>	<b>6447600</b>	<b>0</b>	<b>0</b>	<b>1500000</b>	<b>0</b>	<b>91938</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9 537 411,00</b>
3	Provision for removal of saline earth from inside the structure and spreading it in low lying areas away from the site by means of manually or mechanically lead up to about 1/2 miles to 5miles.	P.100 Cft	15000	0	579	300	0	0	0	0	0	200	0	0	0	0	0
	<b>Total</b>			<b>0</b>	<b>550050</b>	<b>285000</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>400000</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1 235 050,00</b>
4	Dry brick on edge paving (with sundried bricks) above the thin layer of Mud mortar, including preparation of bed by watering, ramming earth and bringing the same to proper camber for draining rain run off away from walls so as to prevent of rain water into the foundation of structure/walls, as required.	P.100 Sft	47000	314,9	1541,6	0	5546	246750	0	0	400	0	470	0	0	0	0
	<b>Total</b>			<b>472350</b>	<b>1464520</b>	<b>0</b>	<b>110920</b>	<b>2961000</b>	<b>0</b>	<b>0</b>	<b>400000</b>	<b>0</b>	<b>108570</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5 517 360,00</b>
5	Construction of Burnt brick approach paths in the streets and lanes of the excavated remains at Mohenjodaro. The paths shall be prepared with 4 1/2" thick dry brick on edge soling over a 6" wall rammed bed of river sand in.	P.1000 Sft	700	4,69	13,37	0	392	0	0	3675	0	0	70	0	0	0	0
	<b>Total</b>			<b>7035</b>	<b>12701,5</b>	<b>0</b>	<b>7840</b>	<b>0</b>	<b>0</b>	<b>44100</b>	<b>0</b>	<b>0</b>	<b>16170</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>87 846,50</b>
6	Construction of collection well in the center of room /hall with perforated wall masonry and duly installing of Geo textile with proper jointing with appropriate solutions and filling/spreading gravel in required rate etc. complete.	P.each well	2	2	6	0	50	0	0	240	0	0	10	22	142	4000	0
	<b>Total</b>			<b>3000</b>	<b>5700</b>	<b>0</b>	<b>1000</b>	<b>0</b>	<b>0</b>	<b>2880</b>	<b>0</b>	<b>0</b>	<b>2310</b>	<b>3300</b>	<b>6390</b>	<b>4000</b>	<b>24 580,00</b>
	<b>Total Qty of Labour &amp; Material</b>			<b>575,94</b>	<b>3401,87</b>	<b>398,4</b>	<b>22769</b>	<b>784050</b>	<b>29520</b>	<b>3915</b>	<b>1900</b>	<b>200</b>	<b>1005</b>	<b>22</b>	<b>142</b>	<b>4000</b>	
	<b>Amount in Rs.</b>			<b>863 910</b>	<b>3 231 777</b>	<b>###</b>	<b>455 380</b>	<b>9 408 600</b>	<b>826 560</b>	<b>46 980</b>	<b>1 900 000</b>	<b>400 000</b>	<b>232 155</b>	<b>3 300</b>	<b>6 390</b>	<b>0</b>	<b>17 753 531,50</b>
																	<b>887 676,58</b>
																	<b>18 641 208,08</b>

The total amount which was calculated comes to 74 564 USD. This is more than what could be provided by UNESCO for these works within the amount provided by the World Heritage Fund. However, as a special grant has been provided by the Government of Sindh to Moenjodaro conservation office, it was with great pleasure that the participants were informed that there will have no problem for implementing the proposed plan being the result of the collective reflection during the workshop. Actually some additional works, some of them already launched (like on paths and canal from DKG to North of canal) will easily be tackled too.

### **2.8.1. Longer term plan**

Taking as a base the initial draft proposal as presented in first mission report after discussion with Moenjodaro team, Sindh Ministry of culture and UNESCO World Heritage Centre, in addition to the themes that had been discussed during the workshop, additional issues were discussed.

The idea was to make sure that UNESCO and the Government of Sindh would have in their possession all information needed to prepare a comprehensive project document for a three year project to be submitted to a selection of interested potential donors.

#### **Items already discussed during the workshop / mission (mostly technical in nature)**

- Drainage
- Underpinning
- Salts
- Capping
- Paths
- Building materials

#### **Additional items discussed**

##### **Research themes to be addressed:**

Building materials with including presence of salts as a specific constraint

Archaeological reports to be explored with specific attention to :

- . Drainage systems (partially covered by Prof. Altaf Aseem)
- . Presence of plastering when excavations were made
- . Use of lime / gypsum
- . Wells
- . Steps
- . Roofing method evidences
- . Masonry details

Recently exposed archaeological remains Mapping studying (Including identified canal towards north (from DKg ?)

**Gathering (conference ?) of experts** on Moenjodaro (and other Harappan archaeological sites) to discuss the question of plastering ( evidences during archaeological researches, potential for conservation today and tomorrow ) raised in article by Dr. M. Jansen (see p.24).

##### **Archives**

Establish list of what is existing at Moenjodaro archives

Identify potential sources (Persons, institutions,..) that could possess additional documents, pictures, ...

Organize documentation

##### **Museum ;**

(to be taken into account? Discussion to be held as museum was not affected by heavy rains, so could be seen as another potential project)

##### **Equipment:**

List already prepared for the laboratory (see 1<sup>st</sup> expert mission report) to be checked

In addition to other equipment already recommended in the same report (water pump) will be added :

- . drone for quick eye bird surveys

- . pneumatic or mechanical rams (for paths and compacted grounds)
- . piezometer for monitoring water table level (to make comparisons with pools existing at the site who can be simple indicators).

### **New documents / Revision of documents**

- . progress reports;
- . special studies / research reports;
- . Documentation of conservation works;
- . Conservation manual;
- . Management plan (see chapter 3 of this report).

As a result of discussions on these issues, a list has been compiled with indicating specific responsibilities that were suggested / accepted by the main stakeholders, though may still be discussed when being implemented according to availability / competences required.

### **A. To be prepared by Moenjodaro team**

#### **1. Data to be further elaborated at the site :**

That concerns:

##### 1.1. Drainage / renewal of flooring system

Based on the numerous existing thematic plans elaborated by end of 2022, elaborate more detailed plans for each area with indicating precisely the level of urgency:

- . very urgent : to be undertaken immediately (emergency plan: before July 2023)
- . urgent : to be implemented in year 1
- . necessary : to be implemented in year 2
- . wished : to be implemented in year 3

##### 1.2. Provision of underground drainage system in DK south area

- . prepare overall design proposal according to existing slopes
- . evaluate needs (size and number of pipes for each section)
- . prepare final design with details for quotation (BoQ)

##### 1.3. Provision of water outlets for all rooms

Based on the existing plans elaborated by end of 2022, elaborate more detailed plans for each area with indicating :

- . very urgent : to be undertaken immediately (emergency plan: before July 2023)
- . urgent : to be implemented in year 1
- . necessary : to be implemented in year 2
- . wished : to be implemented in year 3

##### 1.4. Underpinning

Revise underpinning / wall condition plan for each area with bringing more details according to level of risk with classifying under three categories:

- a. High level of risk (major gaps in the structure, high walls,...), thus to be treated (or stabilized with temporary measures) before the 2023 monsoon
- b. Medium level of risk , to be treated in year 1
- c. Low level of risk (need only regular inspection before potential treatment during years 2 and 3

##### 1.5. Capping

Revise existing plans for each area with distinguishing:

- . walls that should be treated before 2023 monsoon (emergency plan)
- . where there is no capping , to be priority for year 1
- . where there is still remains of capping , to be treated during year 2
- . where there is still sufficient capping that can wait for year 3.

#### 1.6. Paths

Revise existing plans for each area (and overall site plan with better indicating priorities:

- . paths to be revised as they are representing a danger to some archaeological structures to be treated before 2023 monsoon during (emergency plan)
- . zones where there is danger to be closed to the public (limited access) before they can be treated
- . sections of paths to be repaired during year 1;
- . sections of paths to be repaired during year 2.

#### 1.7. Prepare plan of the overall sites indication slopes and temporary pools / existence of protective dykes between areas (see plan in museum, dykes dating back from first half of 20<sup>th</sup> century).

Prepare plan indicating old dykes, slopes and temporary pools with in mind the need to evaluate works to be undertaken to re-level the site to avoid the formation of pools during rains and better functioning of circular drain

Identify areas with high salt content (crust at ground surface)

#### 1.8. Prepare plan of the state of the circular canal / identification of volumes to be cleaned

Mainly three assets need to be evaluated :

1. Vegetation (trees and plants)
2. Silts deposits
3. Other specific items (e.g. pathway to school building, ...)

## **2. Revision of data / Bill of Quantities / new quotations**

#### 2.1. Revise the existing rate analysis sheets taking into account the new specifications that have been agreed upon (improvement of conservation practices thus requiring additional materials / time

#### 2.2. Rate forms analysis could also be revised (prices) according to results of exploration for best quality bricks production)

#### 2.3. Overall bill of quantity to be revised with clear distinction between:

. Emergency action plan, to be fully separated and subtracted

. 3 year plan, based on the distinction made in chapter 1 (above) on the priorities for each year. It will be presented in separated excel sheets for each year (that will help planning release of funds but also adapt to inflation risks).

#### 2.4. Getting quotation for a variety of solutions for cleaning the circular canal

#### 2.5. Getting quotation for pumping system from circular canal to Dadu Canal

#### 2.6. Getting quotations for the underground drainage system at DK south

- 2.7. Getting quotation for making openings in the old dikes and releveling of the site so as to get gentle slopes towards circular canal
- 2.8. Prepare an evaluation or get quotations for removal (scraping) of salt crusts at the ground surface where identified
- 2.9. Enquire possibilities for having access to an upgraded internet connection and evaluation of cost

### **3. Proposal for the gradual implementation of all works planned (over 3 years)**

On the basis of the results of activities described at point 1 and 2 above, prepare a graphic presentation (excel sheet) of the implementation of works over the three years of the project with indicating periods of implementation for each area using data extracted from bill of quantities, with as done for the emergency plan data on the number of days that a team needs for implementing works (per team).

#### **B. To be prepared by UNESCO expert**

##### **1. List of equipment to be acquired for 3 year project**

Laboratory

A list has already been prepared for the upgrading of the laboratory.

This list will be checked by Moenjodaro team / UNESCO office in Islamabad

Other items listed

- . high performance drone / camera to be added
- . pneumatic or mechanical rams for fastening work on paths and compacted grounds
- . piezometer for monitoring water table level (to make comparisons with pools existing at the site who can be simple indicators).

##### **2. Laboratory installation and training**

A first project has already been drafted (first mission report).

Contributions are welcome to fine-tune it.

##### **3. Proposed research program**

The research program to be undertaken from the beginning of the implementation of the 3 year project will be drafted (2 page document). This research program will cover the following topics:

Raw and building materials (including issues related to salt)

Archaeological reports to be explored with specific attention to :

- . Drainage systems (partially covered by Prof. Altaf Aseem)
- . Presence of plastering when excavations were made
- . Use of lime / gypsum
- . Wells
- . Steps
- . Roofing method evidences
- . Masonry details

Recently exposed archaeological remains mapping & studying



Canal towards north (from DKg ?

**4. *Proposed experts gathering (conference and debate on conservation strategies adapted to Moenjodaro WH site)***

A gathering of experts on Moenjodaro (and other Harappan archaeological sites) will be organized to share knowledge / experience on maintenance of these sites both in the past (historic time, with potential evidences of maintenance / repair practices) and today (practices, difficulties met / solutions envisaged) with a specific focus the question of plastering (evidences during archaeological researches, potential for conservation today and tomorrow ).

A brief paragraph will summarize the idea and an overall evaluation of the cost of the organization of such an event will be proposed.

**5. *Proposal for elaboration of new documents / Revision of existing documents***

Evaluation of costs, participation (who) and time frame for the preparation of the following documents will be proposed

- . progress reports
- . special studies / research reports
- . Documentation of conservation works
- . Conservation manual (revision)
- . Management plan

**C. *To be prepared by UNESCO Office in Islamabad***

**1. *Draft project / evaluation for upgrading Moenjodaro Archives / documentation center***

- a. Identification of potential sources (Institutions / experts)
- b. Collection of documents / pictures / plans / reports
- c. Digitalization of documents
- d. In-situ and online access
- e. Evaluation of costs and planning

**2. *Draft project/ evaluation for Moenjodaro museum facilities / collection***

- a. Upgrading of existing museum facilities / exhibition / storage
- b. Process of reflection for planned extension of the museum
- c. Valorization of the specific qualities / values of the existing museum building
- d. Evaluation of costs and planning

### 3. Matrix for conservation plan (5b)

The issue of conservation plan was discussed as part of session 7 of the workshop though for the clarity of the reporting with regard to the UNESCO expert ToRs, it is presented as a separate item.

What was first presented is the evolution of the concept of planning within the framework of the implementation of the 1972 convention related to cultural and natural world heritage. Since the end of the 20<sup>th</sup> century it has become clearer and clearer that heritage conservation should not only consider simple physical protection and making sure that the Outstanding Universal Value of the sites be kept, but adopt a multi layered approach to management that takes into account social, economic and environmental concerns. That would provide a basis for giving the heritage a function in the life of the community, as embodied in Article 5 of the Convention. This more holistic approach has led to a shift from conservation plan towards the concept of conservation and management plan, if not just simply management plan.

Existing resources on the elaboration of management plans have been quoted, more specifically those that can be found in the UNESCO World Heritage Centre web site with a more specific reference within “The World Heritage Resource Manual Series”: Managing cultural world heritage.

<https://whc.unesco.org/en/managing-cultural-world-heritage/>

In this regard it has been stressed that cultural heritage need to be considered as places where social and cultural factors have been and continue to be important in shaping them, rather than as a series of monuments offering physical evidence of the past.

This wider scope of heritage has led to recommend that many more players or stakeholders be involved in heritage management towards the development and implementation of an agreed vision that takes into account both the physical and social contexts. Such a more inclusive approach to heritage management has the advantage to ensure a good integration of the site (and activities related to it) within the broader spectrum of sustainable development in its surroundings, both involving and to the benefit of the local community.

To that end it has been suggested that stakeholders such as local decision makers, police, army (airport), representatives of the local community, artisans, souvenir shop owners, etc. would be involved at a stage or another so that their concerns /expectation / ideas could be taken into account with potentially synergies being found for the elaboration and moreover implementation of some aspects of the plan.

That would of course not refrain Moenjodaro conservation team from keeping full responsibility though additional resource persons (national and international experts) could be invited to participate to assist both in the definition of the process and to provide external eyes for taking stock of the situation in a holistic way.

After having reflected on these consideration, a draft “table of content” of such a plan for Moenjodaro was presented by UNESCO expert, which was discussed and led to some suggestions by the participants concerning stakeholders to be involved and first ideas on what could be done to help the local community, with a very specific interest in the current situation as many people are still suffering from the high floods that occurred in 2022.

**What a management plan for Moenjodaro World heritage site should probably contain (to be further elaborated with all stakeholders)**

**Part A : Description**

1. Brief description; OUV + criteria ; Statement of authenticity / integrity
2. Map showing the boundary of the core and buffer zone.
3. Rules applying to these core and buffer zone
4. History of excavations
5. History of conservation with a critical approach
6. Description of the site to date
7. State of conservation and conservation requirements (maintenance)
8. Museum description
9. Other visitors facilities
10. Visitors and visitors management
11. Staffing and overall management structure / decision making levels / office facilities and equipment
12. Development issues within the local community / Larkana District

**Part B, analysis of the situation and proposed overall response**

13. SWOT analysis of the situation: Strength, weaknesses, Opportunities and threats
14. Vision and / or Guiding principles for the future of Moenjodaro

**Part C : Plan for 10 years**

15. Management mechanism and responsibilities (if to be different)
16. Objectives and strategies
  - a. Research
  - b. Conservation
  - c. Equipment
  - d. Facilities (offices, museum, park, ...)
  - e. Visitors / visitors management / communication
17. Time frame for implementation

**Appendixes**

- Extract of law on heritage applicable and other legal documents
- Maps and plans
- Bibliography

# Appendixes

## Appendix 1

# Follow-up activities to first UNESCO emergency mission following disastrous rainfall in August 2022

## First zoom meeting, November 16, 2022

### Participants :

Abdul Fateh Shaikh, Culture Tourism, Antiquities and Archives, Ministry of Culture, Sindh  
Altaf Aseem, Archeologist, Professor, National expert  
Syed Shakir Ali Shah, Director, Moenjodaro Conservation Office  
Ali Hyder, Deputy Director, Moenjodaro Conservation Office  
Aziz Jawad, UNESCO Ahmedabad  
Nao Hayashi, UNESCO WHC, Paris  
Thierry Joffroy, Architect, UNESCO expert

### Agenda :

#### 1. Preparation of plans.

- f) . Progress made on preparation of plans indicating existing drainage system : runoff paths and rooms without water outlet.
  - . proposal for adding highly affected zones (gullies)
- g) . Progress made on preparation of plans showing the state of conservation of walls: 6 entries
- h) . Progress made on preparation of plans showing the state of the capping
- i) . Progress made on preparation of plans showing underpinning needs (minor ones)
- j) . Progress made on preparation of plans showing pathways and indicating the state of conservation and their potential negative impact (direct / indirect) on some of the structures

#### 2. Preparing for printing these plans (tool for operation)

#### 3. Archaeological study (research in the archeological reports)

- a) Progress made on identification of assets linked to original drainage system and rain water collection
- b) Proposal to add an item on Earthen structures (platforms, Jansen report indicating upper part of the walls built with bricks.
- c) Proposal to also add potential info indicating specificities of wall structures at different periods (more specifically possibly differentiating fabric of the Early period to that of the Buddhist period).

#### 4. Progress made at site for :

- a. cleaning of debris
- b. undertaking regular maintenance
- c. needed preventative works (to be done before next monsoon).

d. Has reinforcement of the team already been possible ? If not when ?

## 1. Issues arising from the presentation of the progress made for the preparation of works on plans (condition survey)

A long series of plans were presented by Syed Shakir Ali Shah, Director, and Ihsan Ali Abbasi, Deputy Director, Moenjodaro Conservation Office, based on which discussions were held. Notes arising from these discussions are presented in black color while original text / list of plans and items to be covered by MCO as agreed by the end of the UNESCO expert mission are in blue.

### 1.1. Drainage plan for the overall site :

This plan will indicate the presence of the main canals, the circular canals and where those drain the water up to the Indus River on the east and the Dadu canal on the west. Condition of these canals will be indicated with five types of conditions considered:

1. clean;
2. silts deposits;
3. huge silts deposits;
4. presence of plants;
5. presence of trees.

Not yet produced

### 1.2. Drainage plans for each site area (7)

In order to be able to prepare a plan for improving the drainage systems at Mohenjo - daro plans of the existing situation have to be prepared for each area. These will serve as a base for preparing a new plans indicating what will be the desired new situations. These plans will indicate the following information:

1. rooms (or courtyards) without water flows outlet (full blue colour);
2. flows of water (using simple blue lines with increasing size at each additional flow to the first one);
3. presence / use of ancient canals (green colour);
4. narrow streets with potentially high flows (red colour);
5. collection areas of exit canals with possibility of detailing more taking into account specific sensitive assets (like narrow streets) (transparent light colours for differentiation of each collection zone);
6. paths floors endangering the walls structures (concrete slabs, precast slabs with slopes leaning towards walls) (orange colour)
7. large canals more specifically those directly linked to archaeological structures (ex; DK area).(large blue colour)
8. main gullies formed and places where wall were damaged due to drainage weaknesses (suggested with using red colour).

The plans already prepared are a good base with an adapted representation mode. Rooms without water flows outlet appear to be fully covered. Concerning the indications provided for the runoff flows, there is a need to go further with :

. being systematic for the whole areas (rooms, narrow and large streets),

. cover the surroundings of the structures as in many cases they are part of the collection areas of the main flows at times with high collection capacities (archaeological debris mounds are also often part of the rainwater collection system).

In addition it is suggested that the data which is now indicated on the plans prepared for the gullies (flooring) would be reported on the drainage plan as the two information are linked.

## 2. Plans showing the state of conservation of walls:

In view of the preparation of the detailed emergency plan to be implemented before next monsoon season, it has been discussed and approved that this variety of situations should be mapped using the following classification:

1. Good state of conservation or minor degradations;  
No need for intervention apart from regular maintenance
2. Degradations but having led to a stable situation  
No need for urgent intervention
3. Degradations linked to failure of the drainage system  
Minor intervention to be linked with revision of drainage works (urgency 1)
4. Degradations with remaining potential of brick falls  
Need to carefully dismantle "near fall" masonry parts and undertake cleaning
5. Sensitive wall structures (high walls with underpinning needs, severe leaning, ..)  
Masonry structures that need a minimum engineering study before intervention (propping, strutting, and detailed preparation / description of method to be applied)
6. Places of specific interest (most of them already spotted, wells, canals, ...)  
Potential added value for the site if restored to be studied.

The plans which have been prepared do not indicate the state of conservation with sufficient differentiation. Specific colors need to be used to represent each of the above listed categories (6).

Additionally to these plans a plan will be prepared for each area indicating:

1. Portions of walls whose capping is in good condition
2. Portions of walls whose capping need maintenance
3. Portions of walls whose capping need full reconstruction
4. Minor underpinning needs (1 to 2 brick layers maximum).

This appears to have been done though not for all areas (Mouneer for example is not covered). This needs to be checked

## 3. Plans showing pathways and indicating the state of conservation and their potential negative impact (direct / indirect) on some of the structures:

Pathways, though not part of the original fabric of the site are important for two main reasons:

. they allow visitors to circulate in the site and thus those should ensure full security

. some paths are located in non pertinent locations and moreover, at times represent a threat to the original structures.

In order to prepare the elaboration of a fully comprehensive plan for the revision of these existing paths it is proposed to prepare:

1. a plan of the overall site indicating main paths with recognizing :
  - a. Materials used (in situ casted concrete slabs, concrete slabs large size, concrete slabs medium size, burnt bricks, earth floors.
  - b. The state of conservation
    - i. Good
    - ii. Needing minor repairs
    - iii. Needing serious repairs
    - iv. Destroyed and needing full reconstruction (or reconsideration / relocation)
    - v. Location of gullies where pipes should be added under paths.

Not done yet !

2. plans for each area (7) but at a larger scale, for detailing the situation for each of them with the following information:
  - a. State of conservation:
    - i. Good
    - ii. Needing minor repairs
    - iii. Needing serious repairs
    - iv. Destroyed and needing full reconstruction (or reconsideration / relocation)
    - v. Location of gullies where pipes should be added under paths.
  - b. Potential negative impact on original wall structures
    - i. Useful, but needing revision of slopes
    - ii. Unnecessary and needing to be removed

The plans already done just indicate the presence of paths. On this base it is now necessary to indicate the information for these two issues, with a selection of colors to distinguish them easily.

## **2. Issues arising from the presentation of the progress made for identification of specific information related to original drainage (and water) systems at Moenjodaro**

Nothing was presented on that issue. Prof. Altaf Aseem however informed that he had some reports and did start to undertake this research, though he indicated that it would probably be difficult to get systematic data. Also some of the information in the reports might need to be checked at site.

This study has been agreed upon as being paramount when reflecting on a renewed overall drainage system for the site – priority to be given to ancient drainage system - it was decided that efforts be made to make sure that archeological reports are made available so that he can undertake this work.



Besides that another issue was discussed, to be addressed at the occasion of next meeting. In an article<sup>3</sup>, Dr. M. Jansen is indicating that archaeological reports give information on the presence of both mud and burnt bricks at the site (and mixt structures). He also quotes the practice in the antic time of plastering walls with mud plasters. Though there are no details on that, while these appear to be paramount information on which future reflection on improved conservation techniques should be based.

This is also an opportunity to recall that today it is difficult to distinguish original and restoration fabric, and moreover, fabric of the different periods (a warning already made by Dr. M. Jansen). Thus, study of archaeological reports should be also enlarged to these consideration with trying to extract all data that could help better differentiation.

### **3. Other items**

#### Access to plans / printing

UNESCO expert is expecting plans already produced to be accessible so that he can work on them, with possibly providing some suggestions on some of them to illustrate the suggestions already in the text (Item 1).

Besides that, it is also expected that printing of all the plans can be available in hard copies for use during the next UNESCO expert mission in January 2023.

#### Presence of slabs / Paths underground

Dr Shakir informed (showing two pictures) that during the cleaning efforts currently made, a street slab was discovered some thirty cm below what has become today the ground floor. He raised the idea that these slabs might be used as support for underground pipes.

After discussion it was agreed that such a system could be studied at the occasion of next UNESCO expert mission. To make that feasible it was also agreed that the extent of these paths / slabs be identified through undertaking some limited diggings at the area concerned. Alternatively (later thought) that could be done with trying to drive an iron bar in the ground to check the presence of the hard surface of such slab.

#### Reinforcing the capacities of the conservation team

The expert was informed that the UNESCO funds had been transferred and that these funds would soon be available at the site to enlarge the team and therefore

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<sup>3</sup> JANSEN, Michael, 2003. « Mohenjo-Daro - Pakistan, The problem of Adobe & Brick Conservation ». In : Pre-print of papers, 9th international conference on earthen architecture, Terra 2003. Tehran : Iranian Cultural Heritage Organisation. p. 309-318.

accelerate drastically the speed of work (cleaning and stabilization). The question remains about potential additional contribution by Ministry of culture of Sindh.

#### Next meeting

It was agreed that next zoom meeting will be held on December 5, 2022, at the same time (2 pm in Pakistan, 10am in France)

# Follow-up activities to first UNESCO emergency mission following disastrous rainfall in August 2022

## Second zoom meeting, December 14, 2022

### Participants :

Abdul Fateh Shaikh, Culture Tourism, Antiquities and Archives, Ministry of Culture, Sindh  
Altaf Aseem, Archeologist, Professor, National expert  
Syed Shakir Ali Shah, Director, Moenjodaro Conservation Office  
Ihsan Ali Abbasi, Deputy Director, Moenjodaro Conservation Office  
Mr. Naveed Ahmed Sangah, Architect, National Fund for Moenjodaro  
Aziz Jawad, UNESCO Ahmedabad  
Nao Hayashi, UNESCO WHC, Paris  
Thierry Joffroy, Architect, UNESCO expert

### Agenda (as proposed by Aziz Jawad, UNESCO Ahmedabad)

1. Progress of team on documentation at the site by Director Shakir and team
2. Progress on research on the drainage system by Altaf Aseem
3. Exact dates of next visit of Expert (By Thierry Joffroy)
4. Workplan for the next visit of Expert (Thierry and other colleagues)
5. Logistics and Funds (UNESCO)

### 4. Issues arising from the presentation of the progress made on the documentation at site

The discussion on that is starting with a PPT presentation by Dr. Syed Shakir Ali Shah showing a selection of the plans prepared by his team.

The quality of the plan are very good and now covers all areas.

From the discussion that follows this presentation, what is agreed upon is that :

**. as proposed a series of plans be specifically prepared for the visitors paths, showing :**

- . the nature of the paths (in situ casted concrete slabs, prefab concrete slabs, burnt bricks, ..)
- . the state of conservation with specific focus on parts highly damaged (gullies, failures, ..)
- . a detailed analysis of places where the presence of these paths (more specifically the concrete slabs) are dangerous for the neighboring archaeological structures).

**. complementary work be done on drainage plans with :**

- . better taking into account the surroundings of the archaeological structures more specifically when the ground level forms slopes towards them (e.g. the sector at DKG south on the north of sections I and II.
- . trying to define collection areas (and evaluate their surface in m<sup>2</sup>) driving water in specific narrow streets canals (so as to identify where major changes of drainage system – for better reparation of flows – will be necessary.

**. on the walls condition plans :**

- . the vision appears to be a bit optimistic for what is considered as “in good condition”.
- . there are more problems that need to be better indicated, more specifically the issue of the leaning out of a number of walls which need to be considered, some of them needing more than just capping as rightly proposed in the specific plan prepared for those.
- . structures with immediate risks of further failure need to be better differentiated from those already fallen down;

. areas where special works or attention will be needed are to be better indicated and listed. Those will be studied during the second expert mission so as to ensure that priorities are well set and that best decisions be taken. It is expected that the team at Moenjodaro As an indication those will include at least :

- . the side walls of the canal from baths at SD area;
- . the “well preserved house” at DKG area;
- . one of the houses at DKG Area with extensive water collection from its northern side;
- . the temple in area HR;
- . the baths canal at HR area;
- . the well (on a platform) situated at the north-west end of area HR (A).

Dr. Syed Shakir Ali Shah also reports that analysis of soli from a variety of quarries present nearby the site have been tested and that most of them contain salts. It is agreed that it is a very sensitive point that will be seriously considered during the second UNESCO expert mission.

## **5. Issues arising from progress made on research on the drainage system by Professor Altaf Aseem**

Professor Altaf Aseem briefly reports on his research. There are quite a number of interesting information in the archaeological reports that he is compiling which hopefully be available before the second UNESCO Expert Mission.

Besides that he expresses concern on the structures that have been exposed during the recent heavy rains. According to him, those present high potential for getting better knowledge on Moenjodaro and they should be studied and probably protected when at risk. This is present in the UNESCO Expert report that will soon be made available, including some first recommendations on this. Those will serve as a base of discussion during the second expert mission in January on this issue.

## **6. Exact dates of next visit of Expert (By Thierry Joffroy)**

During the first mission, it was agreed that the second mission would be organized in January so as to leave sufficient time to the team at MCO to prepare all necessary documentation.

Based on that the overall program of the expert has been set.

Jawad Aziz (UNESCO Pakistan) is asking whether it would be possible to push this mission to the second week of February. However, both due to the expert constraints but also the need to keep a good rhythm of reflection and also action at the site before next monsoon, it will be better to keep to the initial proposal.

As requested by most of the stakeholders so that a good amount of time can be spent on the field, the mission duration has been extended as compared to the first one. It is planned between 14 and 25 January 2023

## **7. Work plan for the next visit of Expert (Thierry and other colleagues)**

Work plan for the next mission will be proposed by the expert before next zoom meeting to be held on January 4, 2023. Before that, it will be important that the expert report which has been finalized be approved by UNESCO so that it can be circulated to all, and thus serve as a base for discussions on what should be done during the mission (and what should rather be part of follow-up later on).

## **8. Logistics and Funds (UNESCO)**

Jawad Aziz (UNESCO Pakistan) is explaining that a first payment has been made to the Ministry of Culture, Sindh, so that the Culture Tourism, Antiquities and Archives department. That has made possible to reinforce the team at Moenjodaro which an additional 14 laborers at the site. UNESCO expert expresses concern about this reinforcement. Though positive, the work to be done at Moenjodaro cannot be underestimated, and it is important that as much as possible is done to implement preventative measures before next monsoon. That requires both the reinforcement of staff at the site but also staff to assist in preparing plans, bill of quantities, etc. Thus, according to him,

efforts to go further as proposed in the note (summary of conclusions) left by the end of its first mission, should really be considered. In addition to laborers at site, it proposes reinforcement of the team through (possibly) redeployment of staff from other sites in Sindh which have not been affected as much as Moenjodaro.

## Appendix 3 –

# Follow-up activities to first UNESCO emergency mission following disastrous rainfall in August 2022

## Third zoom meeting, January 4, 2023

### Participants :

Abdul Fateh Shaikh, Culture Tourism, Antiquities and Archives, Ministry of Culture, Sindh  
Altaf Aseem, Archeologist, Professor, National expert  
Syed Shakir Ali Shah, Archeologist, Director, Moenjodaro Conservation Office  
Ali Hyder, Archaeological Engineer, Deputy Director, Moenjodaro Conservation Office  
Mr. Naveed Ahmed Sangah, Architect, National Fund for Moenjodaro  
Aziz Jawad, UNESCO Ahmedabad  
Nao Hayashi, UNESCO WHC, Paris  
Thierry Joffroy, Architect, UNESCO expert

### Proposed Agenda

- . Report by Dr. Ali Shakir Moenjodaro team on progress made on mapping / quantifying (Bill of quantities)
- . Report by Prof Altaf Asseem on progress made on the study of archaeological reports
- . Issues / questions arising from the Expert 1<sup>st</sup> mission report
- . Objectives of the 2<sup>nd</sup> mission / Official ToR
- . Proposed mission programme

### Minutes :

#### **1. Report by Dr. Ali Shakir Moenjodaro team on progress made on mapping / quantifying (Bill of quantities)**

Dr Ali Shakir is presenting a power point that includes 7 maps covering the theme, paths as separate info from other issues, as had been requested during second meeting all the areas + an overall map !!!

The maps cover the 6 site areas individually and an additional maps covers the entire site, also including the overall drainage system.

These maps are very comprehensive and will be very useful in the near future.  
Though few recommendations are made.

1. Make sure that the orientation is always the same (North on top of the map) for easier use;
2. Concerning the overall site map showing both paths and drainage slopes, it would be interesting to divide it into two different maps;
3. For this overall site map for paths, better indicate pipes / bridges for crossing gullies (runoff) and their state of conservation (overall site plan mainly);

4. For the overall map of drainage, please consider adding temporary pools, and details on the state of conservation of the main canal (tree and vegetation growth, banks falls, ...);
5. "The expression "to be rebuilt" also needs to be taken with care as decision on such reconstruction might not be systematic, depending on actual needs and potential for relocating paths in best locations and with less risks on archeological strictures.

The PPT ends with a presentation of most sensitive areas. The choice is OK, though the Stupa structure needs to be added. Discussions will be held during second mission on what to be done at these places and when it should be done according to level of risk / priorities defined. To that end it is asked that all potential information (photographs, sketches, descriptions) be gathered from a) archaeological reports and b) restoration works specifications / reports.

The PPT presentation is followed by the work having been done on BOQ for the works envisaged.

Those cover :

- . Underpinning :
- . Reconstruction
- . Mud slurry
- . Mud capping
- . Removal of polluted (salty) soil
- . paving
- . Repointing
- . Restoration of paths
- ...

A theme yet to be covered is the overall revision of the drainage system;

The figures are presented as total which will be difficult to use when addressing the need for long term pacification. It is thus suggested that all the details of the calculations be kept and presented in a single table so that this planification work will be facilitated.

The BOQ is also giving indication on unit costs and total costs. Though these figures are very interesting and will be useful, it is raised that such figures should be taken with care as many items might be subject to inflation rates. Thus when planning on long term that should be anticipated as much as possible.

## **2. Report by Prof Altaf Asseem on progress made on the study of archaeological reports**

Prof. Altaf Asseem is presenting his findings with first presenting a list of items covered:

- . roof level and vertical pipes / canals
- . bathrooms and their specific drains;
- . streets drainage;

A number of photos from archaeological reports have been identified: examples are shown;

Prof. is insisting on the fact that though information exists, it would be clever to make possible verification at site and possibly to undertake specific archaeological research before some works be done at specific locations.

This leads to recommend that a first brief synthesis of the information gathered be organized for use during the second expert mission. On that base, and in situ observations, it will then be possible to plan what could be done at various places, and making choices for the places where some complementary archaeological research should be organized.

## **3. Issues / questions arising from the Expert 1<sup>st</sup> mission report**

Apart from UNESCO representatives who have already worked on the edition of the expert

intermediate mission report, the participants to the meeting ask for more time to be able to read it from a to Z. It is thus agreed that efforts should be done to send comments suggestions before the beginning of the second mission so that those can be take into account.

#### 4. Objectives of the 2<sup>nd</sup> mission / Official ToR

UNESCO expert is making a suggestion for some slight changes in the second mission's objectives

##### **Initial ToR:**

Organize a two days training workshop that will cover:

- a. engage with local stakeholders to define guiding principles of conservation and disaster risk reduction;
- b. discuss and develop a matrix for a detailed management plan for the long-term to be further elaborated by the national authorities.

##### **Deliverables:**

Training Workshop report;  
Matrix for conservation plan

##### ***Suggestion for adapting according to progress already made and conclusions of 1<sup>st</sup> mission***

Organize the overall mission under the form of a workshop for maximum interaction, including sub-sessions on –site

Engage in more than a matrix towards an overall framework for a three to four years strategic plan, including its overall cost evaluation.

##### **Deliverables:**

Training Workshop report;  
Matrix for strategic plan

All participants agree on this change, as being logic with both ensuring the best participation of all experts present in Moenjodaro to the definition of the long term restauration project including research, training , capacity building, revision of conservation manual, and elaboration of management plan. Jawad Aziz is informing that some donors are already ready to contribute to such a project and that will probably require some specific list, of equipment for example.

#### 5. Proposed mission program

##### **Proposed expert mission program**

Friday 13	Departure from France
Saturday 14	Arrival in Karachi at 10.35 Meeting with Ministry / Archeology . Departure to Moenjodaro
Sunday 15	Morning Overall discussion on first mission content / objectives Identification of specific key issues to be addressed / specific places at the site to be studied Preparation of a more detailed mission program / setting of responsibilities Afternoon: Beginning of workshop / introduction on objectives, methods and program Session 1 : Discussion on quality of raw materials and building materials
Monday 16	Session 2 : Drainage & canals
Tuesday 17	Session 3 : Capping
Wednesday 18	Session 4 : Underpinning
Thursday 19	Session 5: Salt



Friday 20	Rest
Saturday 21	Session 6: Study of places "at risk" + Stupa: discussions on works
Sunday 22	Session 7 : Overall planning / Works – Research- training - publications
Monday 23	Morning: .Closing meeting at Moenjodaro Afternoon: ;Transfer back to Karachi
Tuesday 24	Final meeting with Ministry of Culture Sindh
Wednesday 25	Departure back to France (departure at 2.50 am)

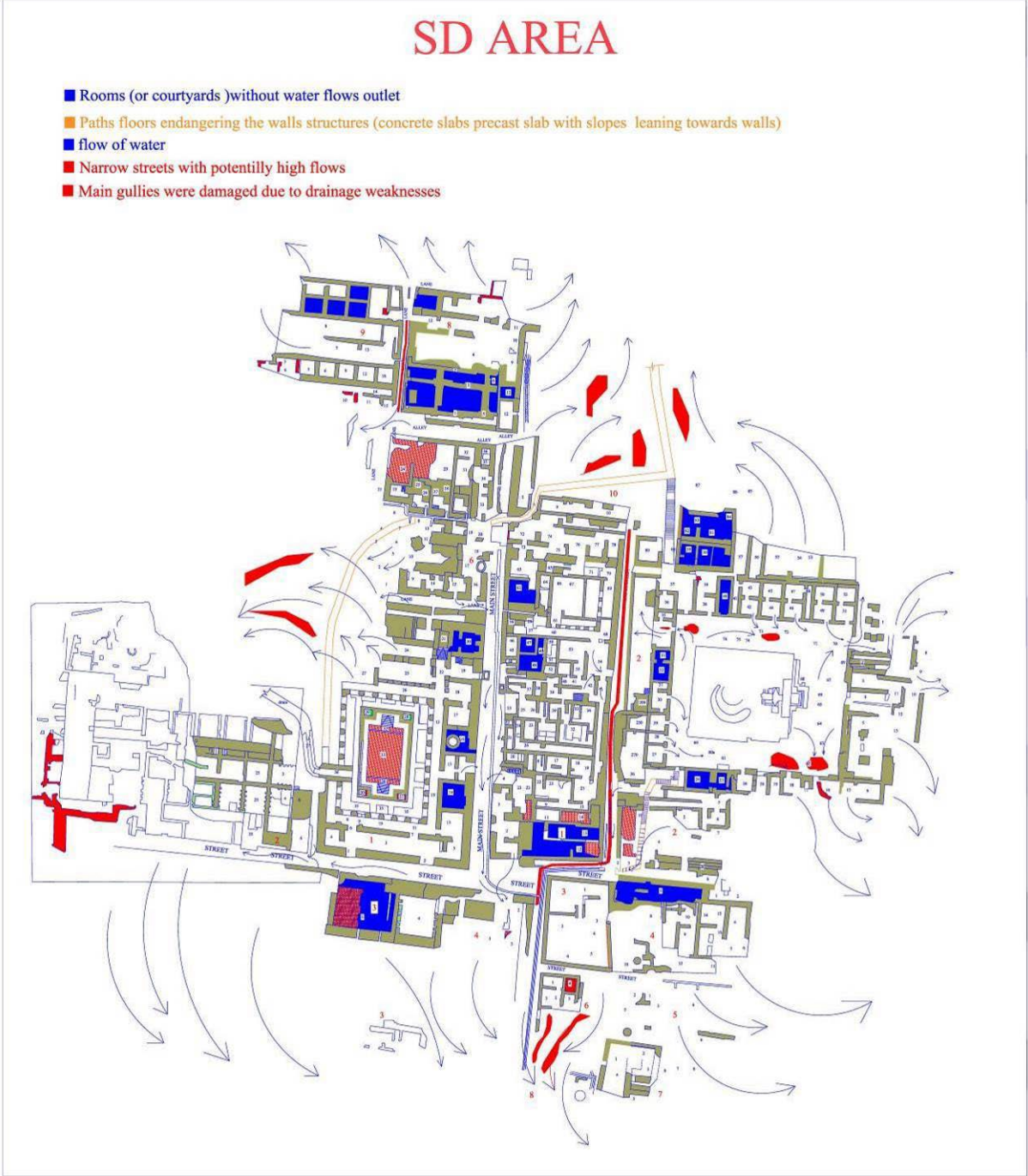
The organization of the session is discussed which results in a proposal for mixed situations with as a main method, the morning comprising an introduction based on UNESCO expert mission report, a theoretical discussion, field visits / inspections and the afternoon being devoted to defining guiding principles and priorities towards draft 3 year project schedule.

Discussions will be held at Moenjodaro and with the hierarchy at the ministry of culture of Sindh do make proposals to UNESCO and the expert for fine-tuning the organization mode and agree on list of participants / modalities of their participation / with possible differentiation for each sessions. There will also have room for last discussions on that just before launching the workshop sessions during the expert mission.

For best preparation of this workshop, it is agreed that the UNESCO expert first mission report would be made available to participants (by Moenjodaro team leaders) so that they can already read it. This would be very helpful to save time for ensuring the planning work be given sufficient time.

The issue of participants of university students to such workshops is also discussed. It is agreed that this should come at a later stage, being part of the long term planning effort to be prepared during the workshop.

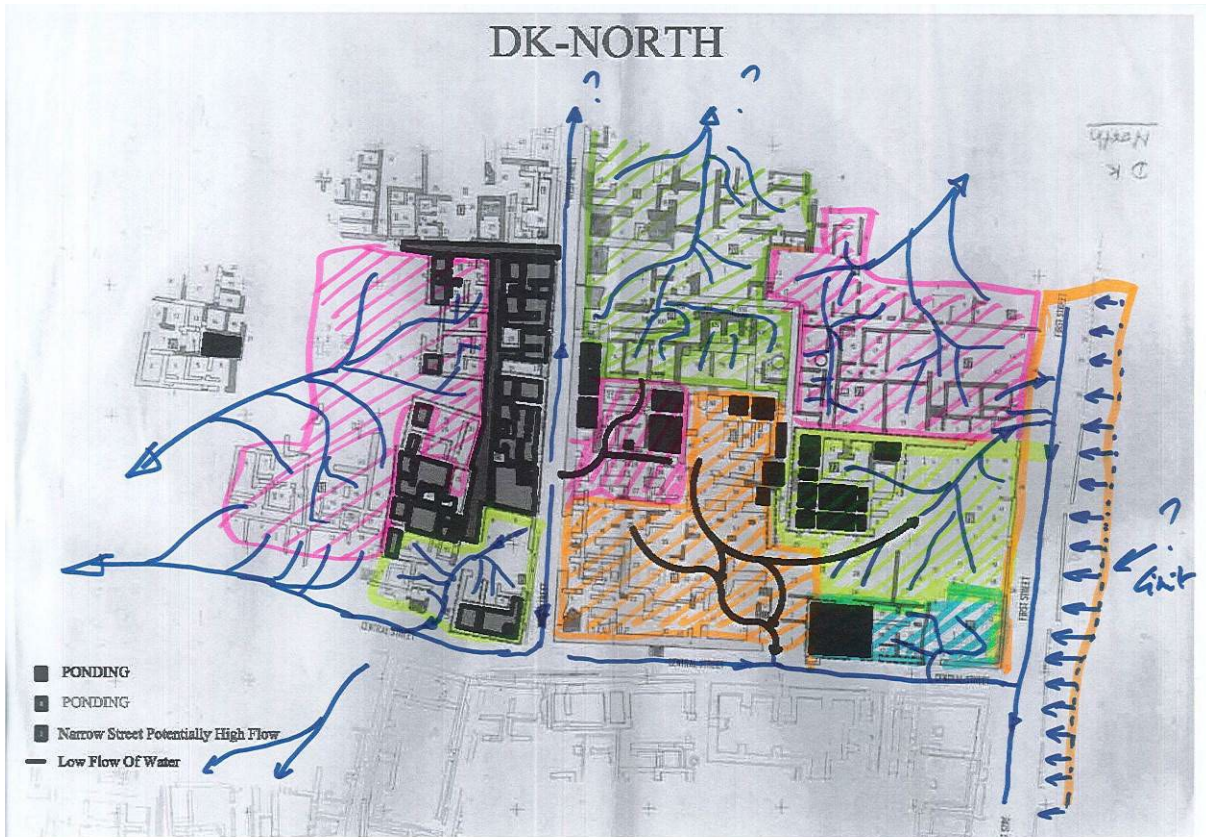
**Appendix 4 – Examples of condition assessment plans prepared by the Moenjodaro team ( situation in January 2023 )**



# V-S AREA

- Good Condition
- Underpinning
- Destroyed and need full reconstruction (or reconsideration)
- Structures disappeared due to passage of time





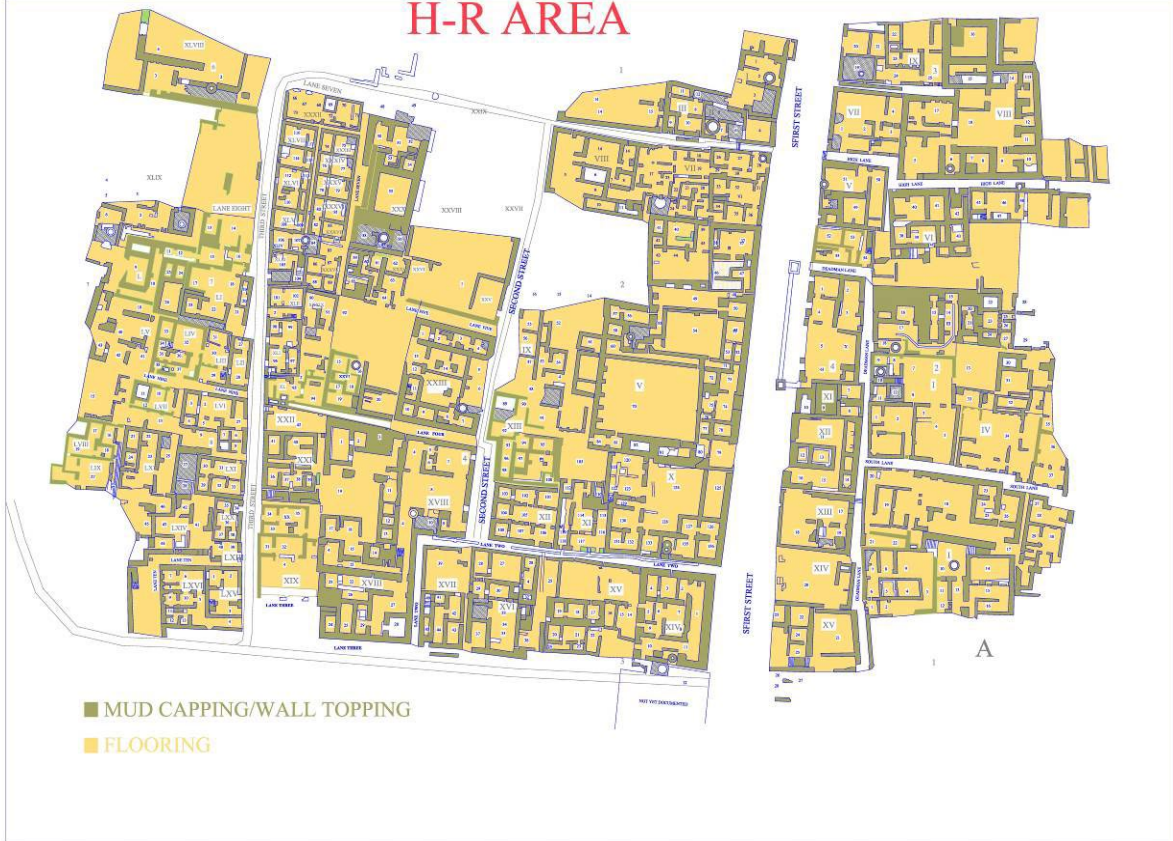
Example of plan provided to illustrate comments made during zoom meeting to MCO team for improving the clarity / pertinence of their production

### H-R AREA

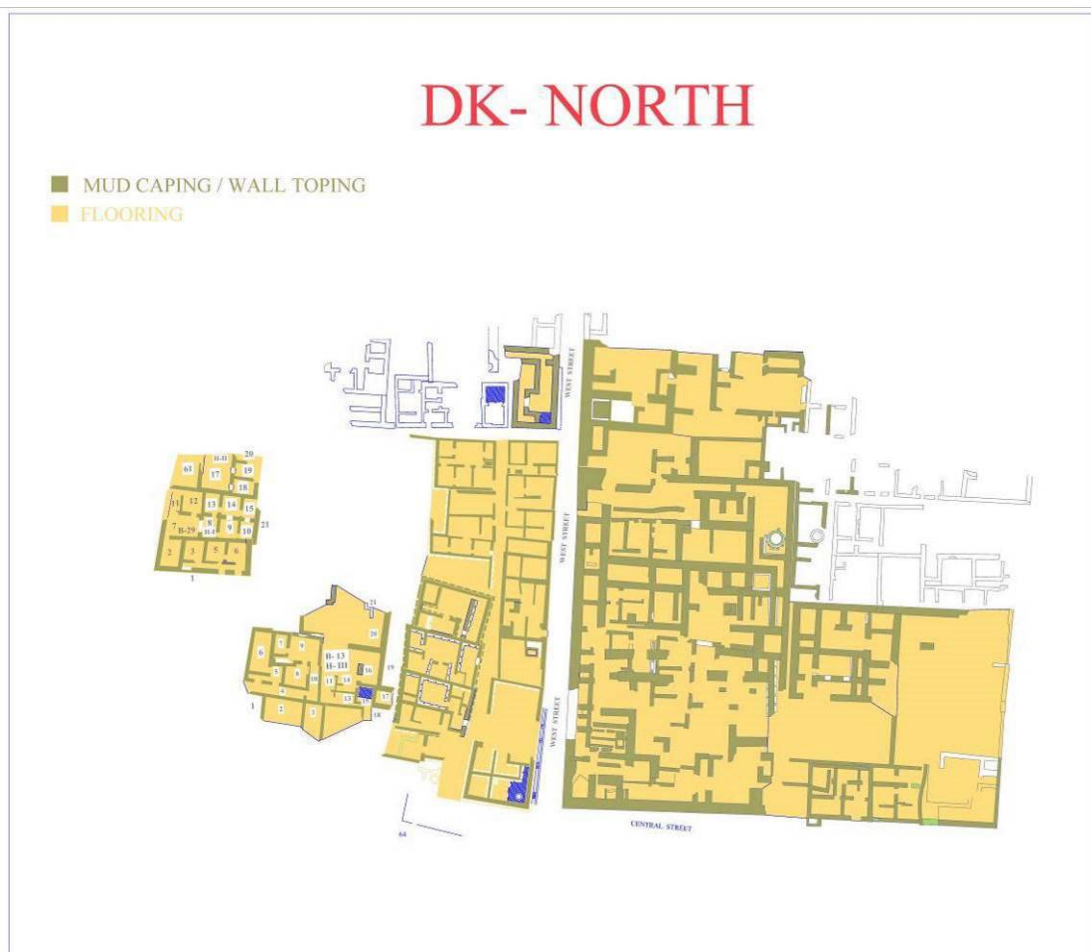
- Rooms (or courtyards) without water flows outlet
- Paths floors endangering the walls structures (concrete slabs precast slab with slopes leaning towards walls)
- flow of water
- Narrow streets with potentially high flows
- Gullies appeared due to weak drainage system

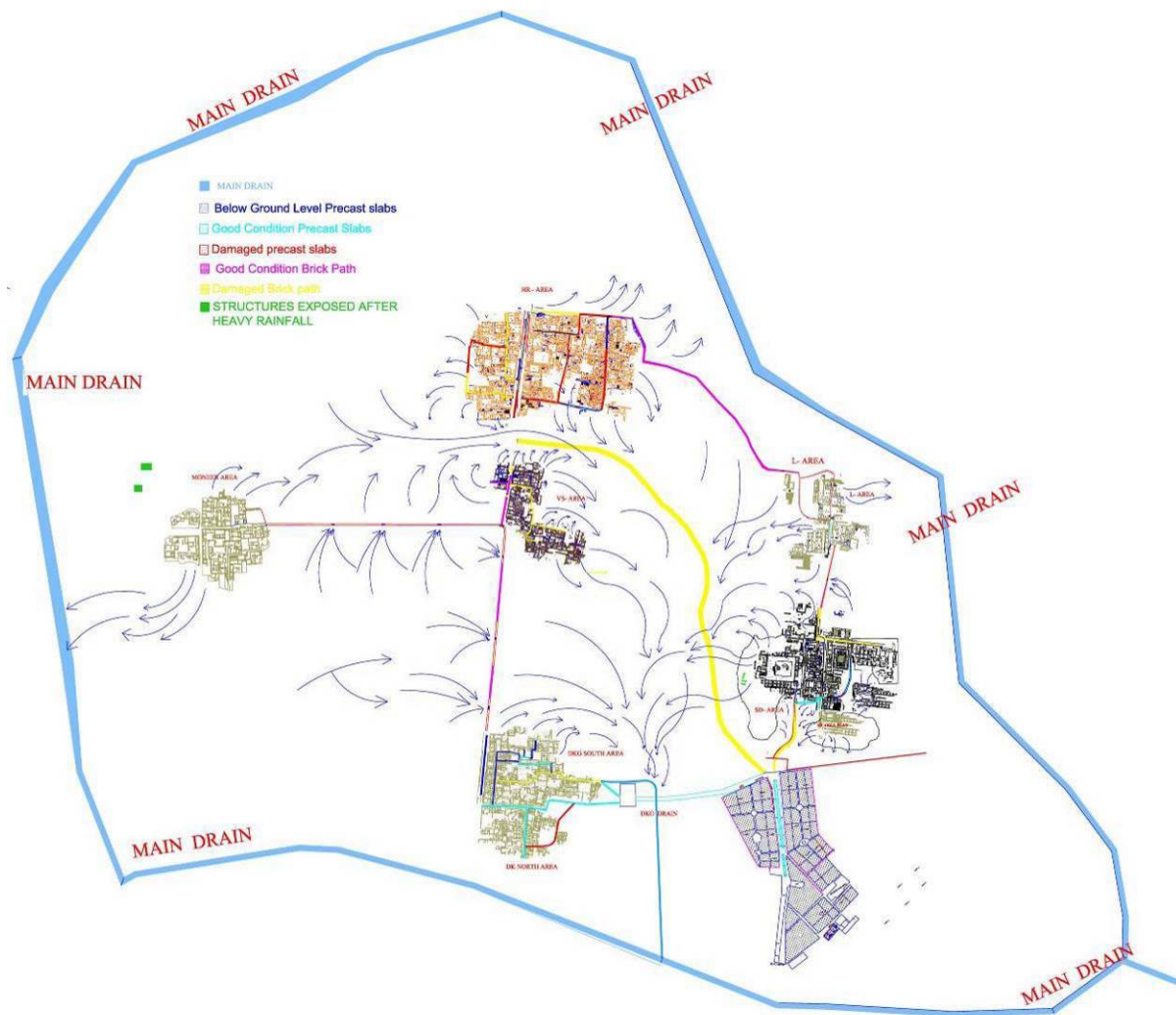


## H-R AREA



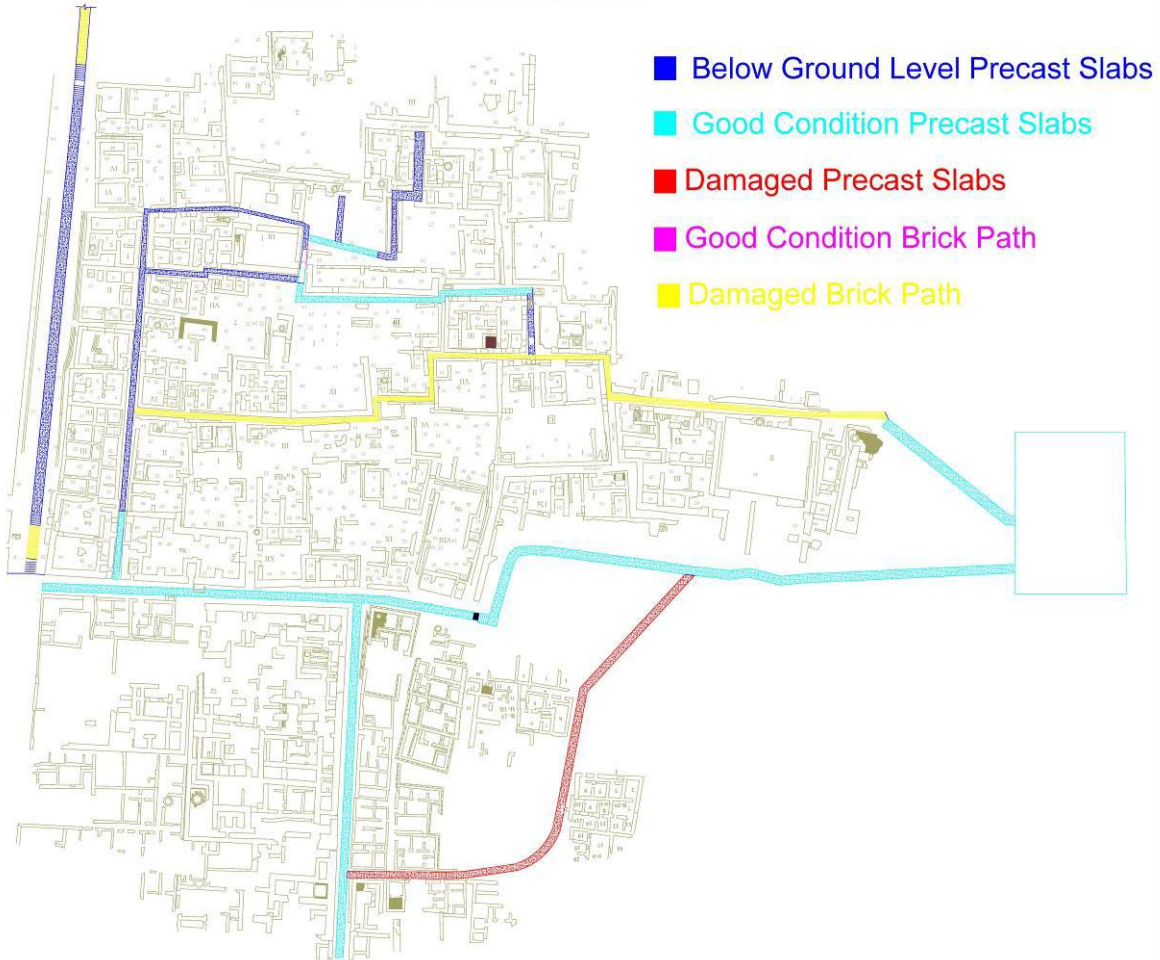
## DK-NORTH





Plan of the overall site showing paths and main drainage slopes / canals

## DKG SOUTH AREA







## DK NORTH AREA

# H-R AREA

-  Below Ground Level Precast slabs
-  Good Condition Precast Slabs
-  Damaged precast slabs
-  Good Condition Brick Path
-  Damaged Brick path



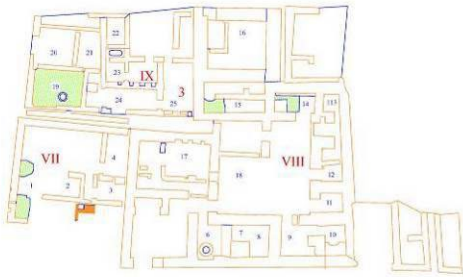
# SD AREA RAIN DAMAGED 2022

-  Good Condition
-  Underpinning
-  Destroyed and need full reconstruction (or reconsideration)
-  Structures disappeared due to passage of time

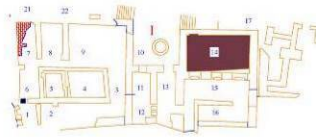




Well on platform on  
HR Area section A



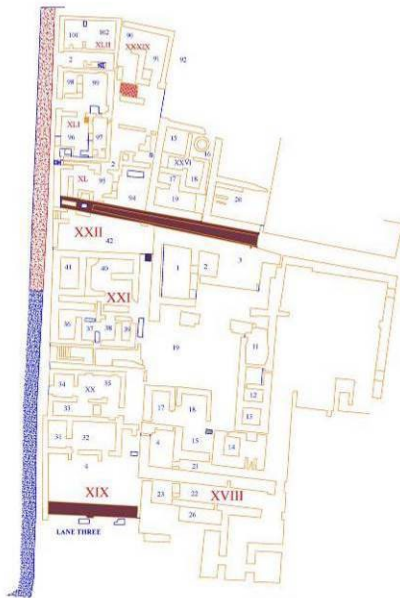
Temple in HR Area



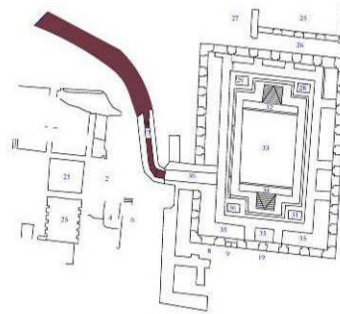
well preserved house



Bath Canal at HR area Section B



Great Bath canal



## Appendix 5 – List of participants to the Workshop

LIST OF PARTICIPANTS, OF WORKSHOP ON  
 “CONSERVATION ISSUES & POSSIBLE METHODOLOGY FOR  
 REHABILITATION OF MOHENJODARO SITE  
 14<sup>th</sup> to 23 January 2023  
 Culture, Tourism & Antiquities Department, Ministry of Culture Sindh  
 in collaboration with UNESCO

1	Dr. Syed Shakir Ali Shah	Director	Mohenjodaro
2	Mr. Thierry Joffroy	UNESCO Expert	UNESCO Expert
3	Dr. Cristina Menegazzi	International Expert on Culture & Heritage,	UNESCO Islamabad
4	Mr. Jawad Aziz	Culture Program officer	UNESCO Islamabad
5	Mr. Ali Hyder,	Archaeological Engineer	Mohenjodaro
6	Dr. Javeria Shaikh	Dean, Architecture	Aror University, Sukkur
7	Dr. Altaf Aseem	Rtd. Professor Archaeology	Member T.C.C NFM Mohenjodaro
8	Mr. Rohal Ameen	Curator	Archaeology
9	Mr. Shabir Ahmed Joyo	Archaeological Conservator	Mohenjodaro
10	Mr. Naveed Ahmed	Architect	NFM Mohenjodaro
11	Mr. Imtiaz Ali	Conservation Assistant	NFM Mohenjodaro
12	Mr. Ali Gul	Conservation Forman	NFM Mohenjodaro
13	Mr. Rahim Bux	Site Supervisor	Mohenjodaro
14	Mr. Rustam Ali Bhutto	Archaeological Conservator	In-charge, WASIL
15	Ms. Sana Gul	Lecturer Archaeology	Aror University Sukkur
16	Ms. Kaneez Umme-e- Farwa	Lecturer Architect	Aror University Sukkur
17	Mr. Kamran Siraj	Lecturer Architect	Aror University Sukkur
18	MS. Mishal Abbasi	Student Archaeology	Sindh University, Jamshoro.
19	Ms. Muntaha Mahar	Student Architect	Mehran University, Jamshoro.
20	Ms. Suaellah Qureshi	Director	Soach Media
21	Mr. Aijaz Ali Mashori	Admin:	Directorate, Mohenjodaro Conservation

## Appendix 6 – Emergency plan – Bill of quantities

Details on why and how this table was produced is described p. 35 of this report.

REQUISITION FOR SIX MONTHS WORK AT MOHENJODARO 2023																		
S.#	Items of work	Unit	Qty	Mason @ RS 1500/P day	Labour @ RS950/P day	Donkey @ RS950/P day	Sweat earth	Sundried Bricks size 11" x 5 1/2" x 2 1/4"	Brunt Bricks special size 11" x 5 1/2" x 2 1/4"	Brunt Bricks 9" x 4 1/2" x 3"	Husk/straw in Mtd	Tractor trolley No. of trap @ Rs.2000/-	POL for sweet water etc.	Geo textile	Gravels/Brunt brick	Miscellaneous /Unforeseen/Solids etc.	Total	
				Nos.	Nos.	Nos.	P.100 Cft	1000 Nos.	1000 Nos.	1000 Nos.	P.Mtd	No. of trap	liter	sq. meter	P.100 Cft	L.S		
	Under panning to the decay and undermined walls with burnt bricks (both old and new) laid in mud mortar. The old salt saturated bricks likely to be reused for the purpose should be free from salt and it can easily be got done by dipping them in canal water for such a time till it is confirmed that no salt lies in	P.100 Cft	2460	1500	950	950	2000	12000	28000	12000	1000	2000	231	150	4500	0	0	
	<b>Total</b>			83025	317832	93480	17220	0	826560	0	0	0	13167	0	0	0	0	1 351 284,00
1	Providing mud capping of the top of the walls with sundried bricks laid in two layers.in convex shape as advised by UNESCO expert on visit in oct: 2022	P.100 Sft	39800	199	927,34	0	15920	537300	0	1500	0	0	398	0	0	0	0	
	<b>Total</b>			298500	880973	0	318400	6447600	0	1500000	0	0	91938	0	0	0	0	9 537 411,00
2	Provision for removal of saline earth from inside the structure and spreading it in low laying areas away from the site by means of manually or mechanically lead up to about 1/2 miles to 5miles.	P.100 Cft	15000	0	579	300	0	0	0	0	0	200	0	0	0	0	0	
	<b>Total</b>			0	550050	285000	0	0	0	0	0	400000	0	0	0	0	0	1 235 050,00
3	Dry brick on edge paving (with sundried bricks) above the thin layer of Mud mortar, including preparation of bed by watering, ramming earth and bringing the same to proper camber for draining rain run off away from walls so as to prevent of rain water into the foundation of structure/walls, as required.	P.100 Sft	47000	314,9	154,16	0	5546	246750	0	400	0	0	470	0	0	0	0	
	<b>Total</b>			472350	1464520	0	110920	2961000	0	400000	0	0	108570	0	0	0	0	5 517 360,00
4	Construction of Brunt brick approach paths in the streets and lanes of the excavated remains at Mohenjodaro. The paths shall be prepared with 4 1/2" thick dry brick on edge soling over a 6" wall rammed bed of river sand in.	P.100 Sft	700	4,69	13,37	0	392	0	0	3675	0	0	70	0	0	0	0	
	<b>Total</b>			7035	12701,5	0	7840	0	0	44100	0	0	16170	0	0	0	0	87 846,50
5	Construction of collection well in the center of room /hall with perforated wall masonry and duly installing of Geo textile with proper jointing with appropriate solutions and filling/spreading gravel in required rate etc. complete.	P each well	2	2	6	0	50	0	0	240	0	0	10	22	142	4000	0	
	<b>Total</b>			3000	5700	0	1000	0	0	2880	0	0	2310	3300	6390	0	0	24 580,00
	Total Qty of Labour & Material			575,94	3401,87	398,4	22769	784050	29520	3915	1900	200	1005	22	142	4000	0	
	Amount in Rs.			863 910	3 231 777	###	455 380	9 408 600	826 560	46 980	1 900 000	400 000	232 155	3 300	6 390	0	0	17 753 531,50
																		887 676,58
																		18 641 208,08