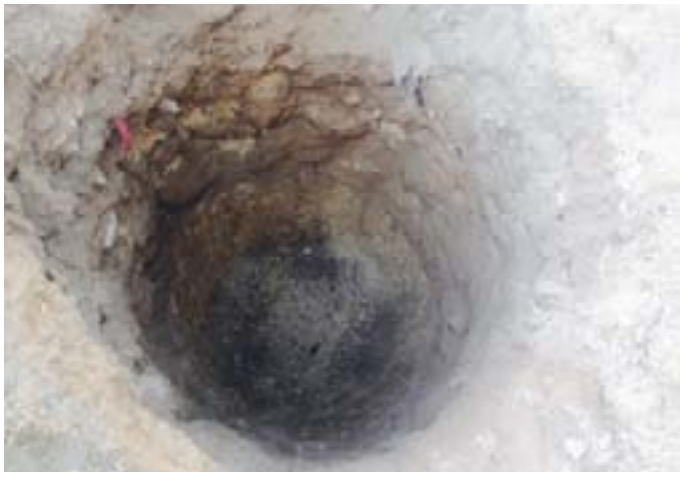
Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-001

January, 2015

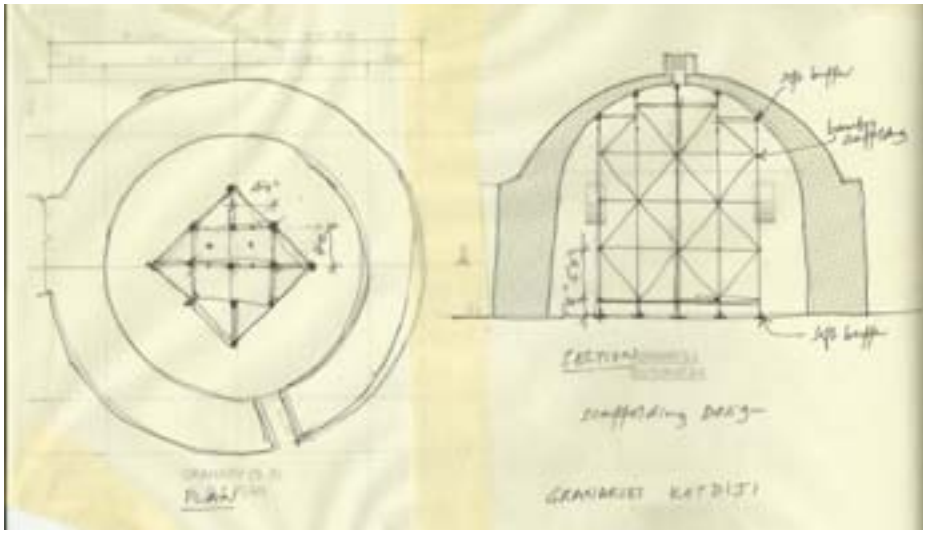
- Before the initiation of the PCF project, Heritage Foundation of Pakistan had undertaken several measures for temporary stabilization of the Granaries. These included
  - > Installation of external scaffolding
  - > Installation of tarpaulin to prevent the ingress of water from the tops of walls
  - > Installation of internal scaffolding to support the existing dome of Granary 5.3.
- The surrounding areas were cleaned and HF teams were mobilized.
- A pit was excavated to determine the level of subsoil water. This activity was undertaken to verify that no ground water ingress is occurring at site. A local survey of the area also concluded that the water table lies below 250 feet.
- Signage was placed at the site indicating work in progress.

Erection of scaffolding

Installation of tarpaulin for temporary protection from rainwater



Excavation of pit to investigate depth of water table



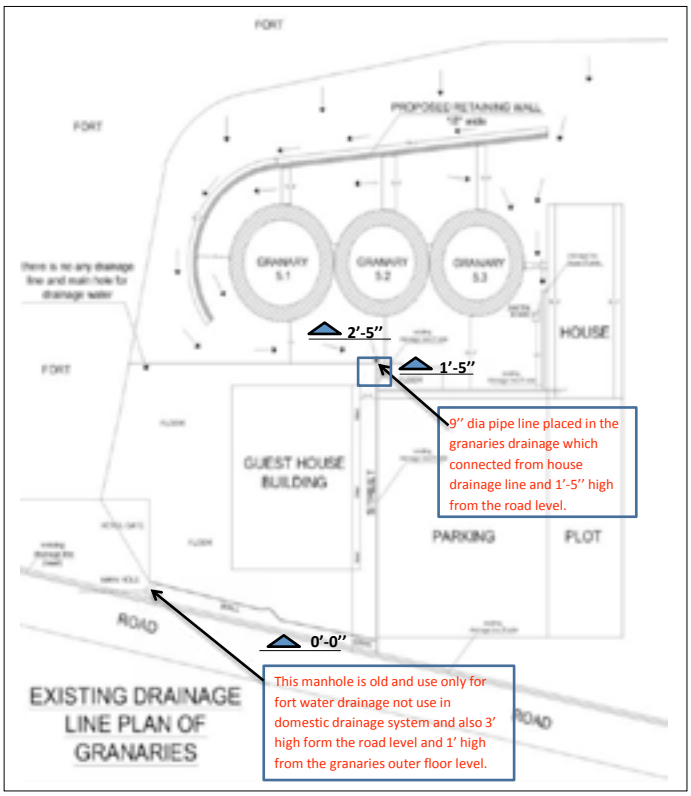
Concept sketch fro Internal scaffolding configuration

Placement of signage at site

Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-002

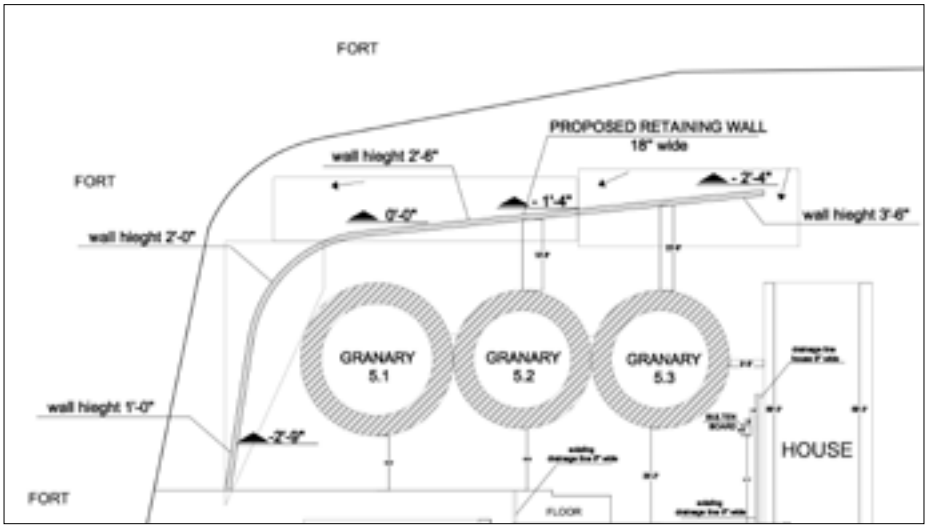
February, 2015

- The granaries lie on a low lying area at the base of the Fort of Kot Diji. This location makes them susceptible to surface water drainage and consequent water damage and seepage from ponding. To combat this issue, through advice from Structural engineer, Amin Tariq and Ar. Yasmeen Lari, it was decided that a retaining wall would be constructed around the property's periphery.
- Investigations were undertaken to document the current municipal drainage system in the area and find a possible solution to drain the surface water into the existing water sewerage system.
- A detailed study was undertaken at the site to investigate the existing system of water drainage and relevant government departments were contacted for information.
- The information gathered was used to prepare a proposal for the location of the retaining wall and possible channels required to ensure that no ponding would occur at site.
- It was estimated that approximately, over 8000 bricks would be required for the retaining wall and Heritage Foundation Artisans spent over three weeks in fabricating them.



Study for existing drainage system around site


Fabrication of bricks for retaining wall



Drawing for proposed retaining wall to be constructed around site


Fabrication of bricks for retaining wall

Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-003

March, 2015

- The Construction of the retaining wall was begun on 10th of March, 2015 and is estimated to be completed in the first week of April.
- Samples were collected for material testing for plaster, brick and mortar for chemical composition and hardness of MOH's Scale. Unfortunately, the laboratory could not conduct the test as the tests required at least 500gms of the historic material. Thus, additional samples were collected by the HF team in Kot Diji and sent to Karachi for testing. Results are expected in the month of April.
- Structural engineer had advised a bamboo lattice to be fabricated and fixed along the internal walls and dome and plastered for reinforcement. The fabrication of bamboo lattices began on 23rd March, 2015

Construction of Retaining wall

Construction of retaining wall

Samples of historic material collected from site

Splitting bamboo for preparation of lattice

Bamboo lattice prefabricated for installation inside granaries

Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-004

April, 2015

- The construction of the retaining wall was completed on the 3rd of April, 2015.
- As part of the aim of the project is for Heritage Foundation Pakistan to train several local persons in various conservation activities, two master artisans and their helpers visited Makli to attend technical training workshops. Activities covered during the sessions were:
  - o Scientific cleaning of historic brick and stone masonry
  - o Preparation of matching mortars and mixes
  - o Re-pointing exposed brick masonry joints
  - o Re-pointing stone masonry in platforms and floors
  - o Checking water consistency of prepared mortars
  - o Curing and monitoring applied materials and approved samples
  - o Underpinning of brick masonry
- Artisan trainees undertook sample patches at Makli and worked with other Heritage Foundation artisans for a few days at WHS Makli to learn the process.
- Based on skills acquired during the trainings at Makli, trainee artisans provided pointing to all open joints in the lower part of internal walls upon their return.
- After due process and curing, lime sand plaster has been applied in order to receive the bamboo lattice.
- After the curing of the plaster, the work of fixing pre-fabricated bamboo lattices began on the 13th of April, 2015. It is estimated that the work of fixing lattices on all granaries will be completed by May, 2015.
- Major cracks along opening were filled in with a mix of slacked lime slurry, gypsum and brick dust under the supervision of HF's Naheem Shah.

Construction of Retaining wall

Construction of Retaining wall completed

Artisan Training held at WHS Makli

Filling cracks with lime, gypsum and brick dust

Filled cracks in dome

Artisan Training held at WHS Makli

Filling open mortar joints at the base of walls

Fixing bamboo lattice to internal walls

Artisan Training held at WHS Makli

Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-005/6

May - June, 2015

- The pointing of the mortar joints in the dome of granary 5.2, started early in May 2015. The ratio used in pointing is 1:10:20 (Plaster of Paris, Lime, Sand).
- It was established through water level process that the granaries are 2'1" below the road level.
- The work of pointing and plaster on lower part of the internal masonry walls has been completed along with bamboo lattice of Granary no. 3.
- A site visit report was submitted by the Structural Engineer Consultant Amin Tariq Associates, that included following recommendations and observations:

Granaries 5.1 & 5.2:

o Poor surface drainage and rainwater splash has resulted in hollowing out of masonry just above grade level.

o The damaged domes need to be retained/ supported to avoid sudden collapse and life safety threat. There should be signage for "danger" and "no entry" all around.

o One of the significant source of rain water damage are the openings in dome which might have been apertures in original fabric but are presently filled with loose brick.

o The cracks more than permissible limits are visible in some parts which need temporary immediate support.

Granary 5.3:

o The masonry walls are to be repaired by re-pointing with lime mortar.

o Underpinning of brick masonry

o Internally, for re-strengthening a bamboo reinforced lime plaster is to be done. Bamboo lattice/mesh size of 6"x 6" for Dome 12"x 12" for walls is to be fixed. Dome must be supported by scaffolding.

o All cavities are to be filled as per original materials. Loose bricks in dome openings are to be removed and sealed to prevent further damage.

o The partially covered and damaged dome openings are to be covered with tarpaulin to prevent rain water from entering the structure.

o The floors to done the slopes to push water away from the structures.

o A plinth protection with toe wall and lime surface is to be made around the granaries to prevent damaging of masonry at grade level due to rain water splash and surface drainage issues.

o The site should be monitored for development of structural issues for which a proper instrumentation and control system should be in place.

Checking the level of the granaries with the water level process.

Directions for removal of debris.

Bamboo lattice on internal masonry on 5.3

Dry cleaning before the pointing of mortar.

Pointing of mortar joints.

Completed filling of mortar joints on the dome.

Prince Claus Fund - CER
Kot Diji Granaries
Special Report After Monsson Rains

July, 2015

During the month of July, Sindh faced extreme weather conditions. The intense heat spells were followed by heavy rainfalls. Protective measures were taken during the conservation work being carried out by HF. The intense heat spells were from late june to mid July, where the month of Ramadan had also started. The rains started from 23rd July onwards.

Prior to the rains work in vulnerable areas of the dome had been completed in order to prevent water ingress and any damage to the dome.

- Removal of loose mortar, and filling and repointing of motar joints in dome masonry,, to avoid any water from entering the domes.
- Underpinning of the top of the wall, and base of the dome. The under pinning of the top played an important role in avoiding of any water seepage through the top.
- The wall and drains around the granary, remained intact while providing protection to the structures, against the heavy flowing rain water from the hill.
- The Dome was covered by a tarpaulin, and successfully stopped seeping of any water in side the granary.
- All cavities were filled as per original materials. Loose bricks in dome openings were removed and sealed to prevent further damage.

Granary 5.3 after heavy rains.

The structure remains unharmed.

The underpinning of the top of the wall protected against rain water.

All the voids were filled and further covering of the tarpaulin.

The wall around the granary to provide protection against gushing rain-

Rain water prevented from collecting by the wall around the granary.

Prince Claus Fund - CER
Kot Diji Granaries
Periodic Report 2015-008

View of three granaries from the Kot Diji Fort. The domes of Granary 5.1 and 5.2 have been lost, while work on Granary 5.3 is in progress.

August, 2015

A visit was made to the Granaries in early August by Senior Architect Ashfaq Ahmad and Project Coordinator Naheem Shah along with Field Archtiect Ubaid to evaluate the work carried out so far and to work out the next steps.

Due to the possibility of rains, the work was mostly continued on the internaal faces of the wall. Since most of the cracks have now been filled in, water penetration has been avoided. However, further work on the extermal parts of the dome will be taken up as the internal strengthening with bamboo and plastering has been accomplished.

In this month strengthening of the dome internally with bamboo lattice is in progress. The plaster has been continued internally in order to provide safety to the structure. The original mud plaster which has disintegrated has been replaced lime sand plaster for strengthening purpsoes. Also, it has been found that burnt bricks have been laid using mud mortar, which had affected the strength of the structure and all loose mortar is being replaced with lime sand mortar. Since the most important factor is to save the dome from collapse, all measures that will strengthen the domed structure are being adopted.

The completion of internal bamboo lattice and re-plastering of internal surfaces is expected to be completed in September. , work will be undertaken on the external surfaces of walls.

Work in progress on bamboo lattice fixing and re-plastering wherever necessary.

View from Granary 5.1 with Granary 5.3 on extreme right.

View from Granary 5.1 with Granary 5.3 on extreme right.

Work on external wall will require underpinning, filling of joints with new mortar and providing. plinth protection / toe arrangement with lime render to provide protection from rain water to the base of external masonry wall.

In September work will also be started on external walls. The masonry suffers from loss of mud mortar from brick joints.

The work consists of underpinning in all areas where cavitites have been formed. Due to the disintegration of mud mortar pointing, it is imperative to remove all loose mud mortar from joints and replace it with new lime sand mortar.

In making test patches, it was found that the joints are very deep, and removal and cleaning of all joints must be done very carefully before new pointing can be carried out.

Accordingly, teams are being formed, who will painstakingly remove all loose mortar and clean the joints, if necessary with a blower. In view of the depth of the joint which vary from 1-1/2" to 2" deep pointing will be carried out in three steps to allow curing and drying before the next mortar is applied.

The entire process will be taken up carefully by treating one section at a time in order not to unnecessarily expose masonry joints to the weather.

Work on developing alterantives for providing cover to Granary 5.1 and 5.2 is in hand. Once Granary 5.3 has been stabilized, work on masonry stabilization of Granary 5.1 and 5.2 will also be undertaken.