1. GEOMETRICAL SURVEY

1.1 Geometrical survey of the laterite enclosing wall

In order to take in account complete data and the real situation of the wall before start the conservation phase, the geometrical survey has been carefully carried out since July 11th. Participated to this work is a Vietnamese team composed by architect Nguyen Anh Tuan and draftsman Pham Le Trung (Institute for conservation of monument, Ha Noi); architect Nguyen Anh Dung (staff of Bureau of Cultural Heritage, Ministry of Culture); and architect Tran Toan Sy (Quang Nam’s Center for Conservation of monuments and culture heritages). The onsite survey phase was finished in the end of July.

The second phase of the survey has been the drawings processing with Auto CAD right after the onsite survey has been completed. This phase was carried by draftsman Pham Le Trung and arch. Tran Toan Sy and has been just finished in September 20th.

Fig. 1 – General plan and laterite wall’s position
1.1. Situation of the wall

After archaeological excavation phase the wall has been completely exposed in the sides East, North, and northern half of the West side. Before cleaning phase all of the wall surfaces were covered by a mixture of soil and debris of laterite, it was unable to distinguish the joint between laterite bricks.

In the west side the wall has quite uniform in height with 3 courses of brick in average. In the North side it was shown in different situations, some parts with 6 courses high and some others with 2 courses remain only. Especially the southeast corner was in an extremely damaged situation; the corner was completely collapsed and deformed due to slide of the ground.
1.3 Building technique

The wall was built with three different layers: the foundation by two rows of brick, the base’s width is 80cm and the body’s width is 60cm. Following the same technical principle of the tower wall, the laterite wall was built with two external leaves by laterite and the core was filled by reused brick pieces and mortar. There are transition moulds between the base and the body of the wall, two on inside surface and three on outside surface.

The survey drawings show clearly the principle of building technique. Two leaves of laterite regularly were built with one brick in longitudinal direction and the adjoining one in cross direction. The laterite bricks were produced with many different sizes but the most common ones have average dimensions are 35 x 20 x 8cm, in particular the longest one is 60cm and the shortest is 25cm.
2. CONSERVATION THE LATERITE ENCLOSING WALL

2.1. Cleaning of the wall surfaces

A decision to clean the wall surfaces has been taken in order to take in account general situation of the wall, and then it was able to set up the principle for preserve the wall.

During cleaning process the deeper survey also was taken. The condition of the internal filling also checked, it seemed to be very fragile, all of brick fragments are loosen and all of the brick joints were deteriorated and remain like soil. All the internal filling parts have been removed as far as it get so that the remains should be only the ones with strong bond.

Fig. 14 – Structure of the wall
Fig. 15 – Original drainage
2.2. Tree roots removal

Some positions of the wall were suffered extremely damage by tree roots. In some cases there were big roots crossed throughout the wall section and all the laterite blocks around were broken. In this case the wall has to be opened in order to completely remove the entire root and clean all laterite debris inside.

In the other cases it was unable to completely remove the root in order to keep the entire structure the decision has been taken is to cut off the root as much as possible and then kill the remains by herbicide injection.

Fig. 16– Bricks were damaged by tree

Fig. 17 – Cutting off the big tree

Fig. 18– Shooting of herbicide

Fig. 19 – One particular big root inside the wall
2.3. Washing by water and soft brusher

After had been cleaned the wall’s structure was shown in very bad conditions either internal or external surfaces. The laterite brick surfaces are loosen like soil, in many positions the grains of laterite were mixed with soil. A solution has been decided to wash the wall with water by soft brusher in order to remove the mixture of the laterite grain and soil.

Fig. 20 – Washing with water and brush

Fig. 21 – Washing of internal part

Fig. 22 – Real condition after washed

Fig. 23 – Wall surface after washed
2.4. Foundation test and reconstruction of foundation

One particular position of the wall, where was suffered strong damage, has been opened until the bed layer in order to study the foundation technique and to stabilize the wall’s structure as well.

![Foundation testing](Image)

![Removing](Image)

![Compressing of preparation layer](Image)

![Reconstruction](Image)
3. PREPARATION OF MATERIAL AND MORTAR

3.1. Laterite

New laterite brick was delivered to the site in sizes of 35 x 20 x 9 (cm) with quantity is 250 pieces. The new laterite has been washed with water by brusher in order to remove clay and soil contain on its surfaces. After washing the real sizes of laterite brick are reduced a little and the brick’s edges are not very sharp. Actually when they were used they have to be cut depending on the size of original ones, which have been reduced due to the erosion.

![Fig. 28– Laterite bricks being washed with water](image1)

![Fig. 29– Ready to use](image2)

3.2. Mortar

Mortar used was made by lime and brick powder in the following quantity:

1 part of shell lime
2 part of brick’s powder very fine (less than 1.6 mm)
1 part of brick’s powder made by 1,6 to 2 mm
4. CONSERVATION OF THE WALL

Considering that the laterite enclosing wall is an important element which is characterized of the G group, the conservation of the wall has been put in activity plan as a priority action of the year 2005’s mission.

Being the strongly damage situation of the wall the first task has to be done is consolidation of the wall’s structure. After all the loose material of the internal part of the wall had been removed it was necessary to rebuild with stable materials. The chosen materials are good reused bricks and the mortar with composition shown above.

4.1. Consolidation of the wall

In order to rebuild the wall’s internal part the reused brick has been selected with suitable sizes and in good conditions.

Before to be laid with mortar the brick had been immersed in water in order to avoid occurred cracks and detachment between brick and mortar due to the strong water absorb action of bricks.

The process has to be done with single or couple of brick course depends in order to have strong bond with laterite promptly.

![Fig. 30 – Before consolidated](image)

![Fig. 31 – After consolidated](image)

![Fig. 32 – Rebuilding the core with brick and mortar](image)

![Fig. 33 – New core](image)
4.2. Fixing of original laterite bricks

There are cases in which original courses or single laterite blocks are staying freely. The situation of those bricks is very fragile and in high risk of collapsing, so it is necessary to fix them in their original position without removing in order to preserve the original figure of the wall. New laterite bricks have been inserted into the missing positions with mortar connecting the entire course. In the other cases of single brick it has been fixed in position by adjoining new bricks. The laterite masonry then has to be consolidated with bricks filling inside.
4.3. Repairing and replacing of new block

When the internal part has completely hardened the inserting of the new block of laterite has been taken in order to repair the damaged masonry or replace the missing ones. First, the new laterite bricks have to be cut to fit with the missing part, meanwhile the new core of the wall was carved out to be met the new brick sizes. Finally the new brick is inserted with mortar to compact the masonry.

In some cases when the wall is extremely damaged in one external part such in the eastern side, it was necessary to rebuild three or four entire courses also the wall core in order to support the opposite part.
4.4. Repairing of original drainages

There are two original drainages locate in two half of the north wall which were found during archaeological excavation. In the ancient time they have taken responsibility of discharging raining water of sacred space around the main temple G1. The situation of two drainages is different but both were broken. A decision was taken to repair two drainages for reuse as their original function.

At first the drainage in the east half was opened. In this position the wall is high 3 brick courses upper the trough brick only. The broken trough brick has been removed and stored as an artefact object; it was then substituted by a reproduced one made from an entire original brick with same characteristics. The damaged laterite bricks were replaced with the new ones.

The situation of the other drainage which locates in the west half of the wall was more complicated, it was covered by at least six courses of laterite above. One of drain bricks was broken and it sloped toward inside instead of outside so drain water could not be discharged.
properly. In this case a decision was taken to be very carefully opening the south leave, which was in worse conditions in order to avoid enlarging dismantling. The same solution then has been taken as what had done with the first drainage; the original broken trough brick has been removed and substituted by a reproduced one with right sloping.
5. PROJECT FOR DRAINAGE IN G3 AND G5

5.1. Project for drainage in G3

In order to discharging the big quantity of raining water inside G3 during rainy season it is necessary to install a system which should be enough ability. Based on the suggestion of architect Pierre Pichard one project has been proposed.

![Fig. 52 – Plan of drainage system inside G3](image1)

![Fig. 53 – Project designing in detail](image2)
5.2. Project for drainage in G5

The quantity of raining water in this monument is surely smaller than in G3 so that one project with same technique but simpler also proposed.

Fig. 54 – Project designing for new drainage system of G5
5.3. Installing of drainage and flooring of G3

Following the project, the drainage system was started to installing in September 15 and completed in October 7.

Tasks of the work:

1. Positioning and drawing on ground.
2. Preparing the bed surface with rammed soil.
3. Installing of supported pipes (iron pipe with diameter of 160 mm) under wall’s foundation.
4. Installing of inspection boxes.
5. Installing and fixing of water pipes (PVC pipes with diameter of 140 mm)
6. Refilling with mixture of soil, lime and broken brick

Fig. 55; 56 – Positioning and preparing for installing of the system

Fig. 57 – Preparation layer by rammed sand and pebbles

Fig. 58 – Checking of the box after laying on place
Fig. 59 – Connecting of pipe to the central box

Fig. 60 – Refilling with rammed clay

Fig. 61 – Filling up with rammed soil

Fig. 62 – Finished central box
Fig. 63 – Laying the iron pipe

Fig. 64 – Iron pipe put under wall foundation

Fig. 65 – Flatting and ramming layer of sand

Fig. 66 – The absorbent pipe was installed

Fig. 67 – Insect preventing net

Fig. 68 – The pipe was protected by clay around
7. The level of final floor was followed the project designing which referred the archaeological research’s report also by architectural proposal given by Prof. Luigia Binda and Arch. Pierre Pichard. The floor was made of:

a. 10 cm of thickness in average of refilling by mixture of soil and lime (ratio 5:1 by volume), well rammed.

b. 10 cm of flatting surface by rammed sand with water.

c. Waterproof layer by wetting rammed clay. This layer is water collected surface also.

d. A layer of pebbles.

e. A covering layer by plastic textile.

f. 5 cm of final layer by mixture of sand and pebbles
Fig. 69 – Clay layer has been finished

Fig. 70 – Pebble layer

Fig. 71 – The pebble layer was covered with plastic textile

Fig. 72 – Filling the last layer by mixture of sand and pebble

Fig. 73 – The final view of G3 in October 7
5.4. Installing of drainage and flooring of G5

After the conservation work of monument’s wall was completed, a new drainage system is installed inside G5 following the project’s drawings.

Tasks of work:
1. An iron pipe was put through the wall’s foundation during reconstruction.
2. Creating of the basin by clay to collect water.
3. Covering the basin and the absorbent mount of pipe by plastic net.
4. Building up the drain system includes inspection box and pipe.
5. Connecting of the pipe with drain system outside.
6. Filling absorbent layer by pebbles up to designed floor level (10 cm of thickness).
7. Cover by plastic textile.
8. Completing of the final layer by mixture of sand and pebbles.
Fig. 74 – Iron pipe

Fig. 75 – Iron pipe put under wall foundation

Fig. 76 – Water collecting basin in NW corner

Fig. 77 – Drain system outside G5

Fig. 78 – Water absorbent layer by pebbles

Fig. 79 – Completed image of G5
6. REPRODUCING OF CHAMPA BRICK


The reproduction of Champa brick which is needed for conservation of G3 and G5 has been carried out by La thap brick and ceramic product factory. The factory locates in Kiem Lam town, which is 9 km far away from My Son site. The quantity and technical characteristic of new brick was requested following the lab test result given by Polytechnic of Milan.

The number of requested new brick was 6000 divided into two amounts:

+ 3000 bricks with dimension is: 320 x 160 x 50 (cm)
+ 3000 bricks with dimension is: 320 x 160 x 60 (cm)

Several visits have been taken in factory in order supervising the production process also preliminary checking of the brick quality.
6.2. Using of new bricks on the site.

The first 200 new bricks delivered at the G group site in September 17\textsuperscript{th} and next 4 times with total number are 720 bricks. Because of delay of new brick delivery the work to cover the wall’s top has been decided to be cancelled. So that the number of brick has been used for conservation of G3 and G5 are 400 only.

![New brick delivered to the site](image1)

![A new brick](image2)

*Fig. 84 – New brick delivered to the site*

*Fig. 85 – A new brick*
7. STABILIZATION OF N-E AND N-W CORNER OF G1

7.1. NE corner

A provisional wooden structure has been put up supporting upper masonry which is in much damaged situation. In order to protect the original brick surface avoiding strong contact with the wooden structure there are sand bags were inserted.

Fig. 86 – The provisional structure supporting NE corner
Fig. 87 – Sand bags are inserted

7.2. NW corner

The sculptured decorative in stone has been repositioned to its original at the G1’s SW basement corner. New reproduced bricks have been used to connect the stone part with original masonry in order to fix the corner.

Fig. 88 – Repositioning the decorative stone
Fig. 89 – The stone has been fixed