SAFEGUARDING MY SON WORLD HERITAGE

- Demonstration and Training in the Application of International World Heritage Standards of Conservation at My Son Group G Monuments -

- 2005 -

Preliminary Technical Report
July 2005
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1. Introduction

During the month of July the main activities have been:

- **Design of Drainage system G3 and G5 by Arch. Pierre Pichard**
- **Conclusion of archaeological excavations on east side of G area, around G5 and G1 and continuation of Inventory activity. (see Zolese’ Report)**
- **Continuation of G3 and Starting G5 restoration (see Condoleo’ Report)**

Arch. Pierre Pichard designed the drain system for G3 and G5. This system has been already installed in a couple of restored Khmer building in Thailand (with similar weather conditions) and after ten years still works very well.
The archaeological excavation has been completed in east side of G area and around G5 and G3 buildings. And some investigations have been done in the area between G2 and G3 by Dr. Federico Barocco.

The architecture activity has been focused mainly in the continuation of G3 restoration and starting that of G5. Meanwhile several experiment of making new brick have been done by using Vietnamese traditional work and kiln.

In this period Arch. Khim Duc from the Department of Cultural Heritage Ministry of Culture and Information, studied and designed a project how to create a covered area to store the main stone artefact on the site. The project proposal is still in progress and under revision after some our suggestions.

During this period the following Vietnamese experts participated to the research and consolidation activities:
Arch. Dang Khanh Ngoc, chief architect, and Arch. Nguyen Anh Tuan, Institute for Conservation and Restoration, Hanoi
Arch. Tran Dinh Thanh, and Arch. Khim Duc Department of Cultural Heritage Ministry of Culture and Information.
Mr. Le Van Minh draftsman and Arch. Tuan Sy, Quang Nam Province
Preliminary Technical Report on archaeological Activity carried out in My Son, Group G - July

By Patrizia Zolese
(Lerici Foundation Chief Archaeologist, UNESCO CTA)

Investigation of the area between the monument G2 and G3.

During the conservative work on the east and north sides of the mandapa, has been possible to carry out an archaeological investigation in this area, performed on the following points:

1. Accomplishment of the excavation on E side of G3 building, to evaluate the possibility to recover the original roof collapsed;
2. Photographic documentation of the collapse found. The entire area has been photographically surveyed using a 1 m² grid;
3. Study and levelling of the original exposed surface, in view to understand the drainage system and the discharge of water in G complex during the Cham period;

North side.
A trench 50 cm wide has been opened along this side.
A silt-sandish layer of recent filling deposit (about 3-5 cm.) arrive to cover the two laterite rows already seen during past excavation.
As already noticed, the mandapa was built on a low foundation composed by two row of bricks 8 cm high and two row of laterite, the second laterite row marks the mandapa basement.

East side.
After the removal of about 3-8 of recent filling has been found a tile layer in primary deposition, relating to the roof collapse of the mandapa after the abandonment of the area.
fig. Roof collapsing in primary deposition found along the E side of mandapa
The tiles were covering almost the entire length of east side (about 7 m.), for 2 m. of width and a gradually missing close to the corner.
Fig. The collapsing has been documented by pictures and grid restitution.

The original position of the collapse allowed the identification of the mainly tile’s type. They showed three different shapes, according to the type of covering in use during the Cham period, and are corresponding to the same type found on the northern and southern side, exposed during the past excavation season (see technical report 2004).
As already said, the tiles are divided in three different types as showed below:

- tile 25/30 cm long, rim 1,5 cm, 1 cm thick and 7/10 cm wide;
- tile of unidentified length, rim 1,5 cm, 2 cm thick and 13-14 cm wide;
- horned tile.
Fig. Some samples of the tiles types recognize in the collapse

N.B. Amongst the different shape of tiles seems to recognize a different quality of clay and manufacture probably due to the different workshops.

The tiles were collapsed on the ancient ground, composed by exposed bedrock. The ground level is corresponding to the base of the 2nd laterite row, confirming it as the base of mandapa platform.

During the past months, has been removed two rectangular blocks in sandstone, probably reused as step. The two steps were placed on a base composed by 4 bricks 30 cm long.
The collapse just described above arrives close to the bricks that are lying on the laterite platform.

After the removal of the first two bricks from south, appears a layer composed by silty-sandish soil mixed to bricks fragment and sandstone flints. According to the type of preparation generally used during Cham period and already seen in the past excavation, those four bricks should be considered as the original preparation for the step of the mandapa entrance in the east side.
Fig. G3, east side, preparation step made by silt-sandish soil, brick fragments and sandstone flints (emphasized).

Fig. Eastwards, the roof collapse arrive under the first step of the east stair of G2.
The correspondence of the topographic levelling is also confirming the authenticity of the collapse, happened after the abandonment of the site and before the shift of the stair.

The steps in sandstone are not in original position, in fact it’s visible a shift probably due to the missing of the filling material of the stair.
2. **G5 foundation test.**

According with the need of the conservative works, also here, have been opened foundation trenches to test the condition of the lower brick rows. Along the external sides has been opened a trench 50 cm wide, in the meantime inside the monument, two trenches checked the lower bricks in the SE and NW corner. After the removal of a recent deposit 4/10 cm thick composed by silt-sandish soil mixed to small fragments of brick and laterite, appeared the two rows of foundation bricks.

As already seen in G1, also here, the two rows of foundation bricks are inserted in the original bedrock by a foundation pit quite narrow.

3. **Eastern side dumping**

**Tr. B8**

In the eastern side of the G group hill, rubble and collapses have been removed in order to obtain a regular ground surface following the stratigraphy identified during the previous phase of the excavation field.
The removal has been carried out, to avoid the loss of important information, being archaeological material still buried. After removing 20 cm of recent silt-sandish deposit, appear the rubble identified as the material cumulated after the American bombing of 1969 and the clearance carried out during the 80’s, to then proceed to remove the dump resulted from the excavation performed at the beginning of XX century by the H. Parmentier. The dumping is composed by selected material, mainly bricks and laterite blocks.
Before the removal, the collapsing has been documented by pictures and grid restitution and then removed.

The dump material collected during the clearance and the excavations performed on the area, has been carefully selected and divided before the recovering.

After the removal, in view of study and of the conservative works, the bricks have been selected in the following order:
- Bricks entire;
- Bricks with at least one side entire;
- Moulded or carved bricks;
- wallettes.
- brick fragments for making powder.

4. **Conservative Intervention on the Enclosing Wall**

Being the enclosing wall an important element characterising the G group, also here it’s started a conservative works addressed to consolidate the internal side of the structure.

The past excavation put in light ¾ of the wall’s length, so that has been possible to detect its typology and its original height.

Following the architectural plan of main building of the G group, also the enclosing wall was built by different material as laterite and brick.

Two rows of foundation bricks support seven rows of laterite blocks on which it was the elevation in bricks.
The base of the wall is 80 cm; after the 3rd row of laterite moulded the width are 60 cm.
and an elevation around 2.50 m.
As already supposed it’s possible to suppose that the wall was decorated by terracotta
finial.

The conservative works of the present season is addressed to the wall side already
exposed during the excavation of the past months.

Fig. The holy area and the part of the enclosing wall interested in the present
conservative work.

Before the intervention, a trench test has been opened in the east side close to the N
corner to check the condition of the foundation rows being here an unusual depression.
Fig. As supposed, the depression in this point happened after the shift of some foundation bricks.

After an accurate archaeological cleaning, the wall has been surveyed by drawing for the AUTOCAD restitution.
Fig. A section of the Enclosing Wall during the archaeological cleaning.
5. **Preliminary works for Closing Mission.**

Preliminary works have been carried out to facilitate the water evacuation. In particular, the G1 cella has been refilled by layer of bricks and sand to preserve the original floor just discovered in the present excavation season.
Fig. Refilling of G1 cella and protection of the exposed section.
1. G GROUP: ON SITE ACTIVITIES

During the month of July, all the architectural activities on the site have been leaded by the architects of DIS: P. Condoleo, F. Landoni and M. Landoni. They supervised the progressing of the conservation and restoration works on G3 monument, they started the restoration works on G5 monument and they continued to test the new materials chosen for the restoration of G group monuments.

1.1 G3: state of art

The works on Mandapa have temporary stopped for the month of July North-West corner, in the West side and in the South-West corner, and they have progressed in the South side, in the South-East corner and in the East side.

1.2 South side of G3.

The dismantling phases of the internal and external layers of the walls of the South side of Mandapa have been proceeded in all the side. The walls have been disassembled until the foundation level only in the parts where the original joint was lost and where the bricks were seriously damaged. (Fig.1).

Also some blocks of laterite was hardly damaged and the removal of some of them were necessary (Figs.2,3).
The damaged blocks of laterite have been replaced with new blocks and fixed with mortar (Fig.4). The internal layer of the foundations has been removed in the parts were the laterite was damaged and it has been placed back and consolidated with mortar. (Fig.5)

Fig. 2 – Foundations with laterite blocks

Fig. 3 – Damaged blocks of laterite

Fig. 4 – Substitution of damaged blocks.

Fig. 5 – Consolidation of internal layer with mortar

The internal layer of the walls has been removed layer by layer because the bricks were seriously damaged and jointed only with soil. (Figs.6, 7.)
The internal layer of the walls is not homogeneous, and its texture is of different kinds, even in every single layer (Figs.8-11)
The reconstruction with the natural resin of the original external layers of the wall started from the connection left in the South-West corner (Figs.12,14) and it proceeded towards East side. At present time, the reconstructions reached the 12th course (Fig.13).
Also the reconstruction with original bricks and mortar of the internal layer of the South side of the wall has proceeded towards East. Another gradual connection has been left in order to better join the part of the wall still to be reconstructed. (Fig.15)
1.3 South-East corner.

Conservation works started on S-E corner and they followed the same procedure used in the rest of the building: every single bricks are numbered with a white chalk (Figs.16-19), the part of the wall is photographed and during the disassembly of the wall bricks are permanently marked with ink and stored. In the reassembling phase brick are placed back in their original positions.
Fig. 17 – East side of S-E corner before and after numbering

Fig. 18 – S-E corner after numbering, general view
The corner has been dismantled and studied layer by layer (Figs 20,21).

During the disassembling of the corner, a decorated brick similar to the ones found in S-W corner has been found right in the corner of the foundations blocks of laterite (Figs.22,23)
The blocks of laterite in the corner were seriously damaged (Fig.22) and their substitution were necessary (Figs.24,25,26).
1.4 East side of G3.

The East side of G3 has been numbered and the disassembly phase of damaged bricks has already started. (Figs.27,28)

1.5 G5 (posha) building: state of art

The conservation works on G5 building (posha), started at the beginning of July. This building was deeply damaged, with an elevation not higher than 60cm (fig.29).
Fig.29- G5 Building before archaeological cleaning

Restoration works begun only after the end of the archaeological excavations of the area surrounding the building and after the geometrical survey completed by the Vietnamese architect team.

In order to have a better view of the general conditions of the building, a preliminary cleaning has been carried out on the surface of the walls and in the joints of the bricks. (Figs.30-34).
Fig. 30 - Cleaning phase, general view

Fig. 31 - Cleaning of the internal layer

Fig. 32 - Cleaning of the joints
In order to protect the walls from the rain during the conservation works, a sheets metal shelter has been temporary placed all over the building. (Figs.35,36).

The intervention begun from the South-East corner (this side of the building was in fact particularly damaged by a tree grown inside the wall) (Figs.42, 43) and it proceeded towards N-E corner and South side.
All the bricks have been numbered and photographed before removing in order to place them back in their original positions by anastylosys. (Figs.37, 38).
Bricks are permanently marked with ink during their removal (Figs. 39-41).
During the disassembly phase the tree inside the South-East corner has been completely removed (Figs. 44, 45).
In order to remove also the roots of the tree, a foundation pit (80x60cm) has been excavated by the archaeological team in the internal side of the corner (fig.46-48). The foundation pit allowed checking the foundations courses and their damages caused mostly by the presence of the tree.
The foundations are composed by three layers of bricks of different sizes and different characteristic in comparison with the bricks of the walls texture. They were placed in irregular way and jointed together with soil and bricks fragments.

Inside the corner of the layer -2 of the foundations a decorated brick, similar to the ones found in G3 monument, has been found during disassembly. (Figs.49-51).
In the layer -3 of the foundations two glazed bricks of big size and another decorated brick have been found (Figs.52-54).
Some pebbles and sand have been found under the last (-3) layer of the foundations (Figs. 55, 56).
The removal of a damaged brick in the internal South side allowed to see the preparation of the foundations made with stone pebbles, sand and small fragment of bricks. (Figs. 57-59)
In the South-East corner it has been opened a further foundation test (30X80 cm) in order to have a complete survey of the foundations. The foundation pit allowed to see the original foundation trench, 7-8cm wide and 15cm deep (Figs.60-62).
Fig. 60 - Ft of the preparation

Fig. 61 - Ft: South section
A mixture composed by pressed soil, bricks fragments, lime and water has been used to permanently fill the foundations pits (Figs.63-68).

In order to make this mixture harder close to the walls, some brick powder has been added to it (Figs.69-71).
Some tests have been made to verify the quality of the mixture (Figs.72-75).

Before placing back the bricks of the -3 layer in their original position some sand has been added on the original preparation layer. The sand was previously washed and sieved in three different sizes and than pressed among the bricks up to its original level (Figs.76-81).
Fig. 76 Sieving

Fig. 77 Sand washing

Fig. 78 Sand washing

Fig. 79 Replacing of the bricks

Fig. 80 Pressing of the sand in the joints
At the same time the consolidation of the three foundations layers in the external side of the wall has been made with lime mortar and bricks fragments.

**Preparation and consolidation phases of the -3 foundation layer** (Figs.82, 87).
Fig. 84 Consolidation of the corner with mortar

Fig. 85 Consolidated corner

Fig. 86 Last foundation layer before jointing with mortar

Fig. 87 Last foundation layer after jointing with mortar
Consolidation phases of -2 courses of foundations (Figs.88-91).

Fig.88 Placing of the internal layer of bricks

Fig.89 Placing of the external layer of bricks

Fig.90 All layer set

Fig.91 Consolidation of -3 course
Consolidation phases of -1 course of foundations (Figs.92, 93).

2. RESEARCH ON NEW COMPATIBLE MATERIALS

2.1 Mortar samples

In order to test the behaviour (depth of carbonation and hardening), of the mortar used in the conservation works, a small wallette has been built using original bricks and natural resin in order to reproduce the same conditions and characteristics of the mortar inside the walls after the intervention. A rectangular hole (16x4cm) has been left in the middle of the wallette to store the mortar sample (Figs. 94-97).
The sample will be taken out from the wallette at the end of September and brought to the Laboratory of DIS - Politecnico di Milano to test the depth of carbonation reached when inside the wall and to be characterized.

4.2 Preparation of new bricks in the traditional way

The decision to start a traditional production of compatible bricks for the intervention is due to the lack of original bricks coming from the excavation of group G. A pond 5km from My Son has been chosen as quarry because of its nearness to the site, its richness of clay and because it has been traditionally used as clay quarry (Fig. 98).

The clay in the pond is not homogeneous; different clays, by colour, consistency and composition, were in fact found in different layers during a first survey of the place (Fig. 99). In order to test the best ones, three different clays were chosen and used to make bricks (Figs. 100-102).
The traditional process for a non-industrial production of bricks is summarized in the following pictures (Fig.103):

- First cut of the clay
- Adding of water
- Foot mixing of the material
After this process the bricks are left to get dry in the sun for one week. After that the bricks are fired.

4.3 Test on new bricks

A first set of bricks produces with previous type of clay was tested in order to compare the characteristics with the original ones. The results of the tests are reported below.

4.3.1 Water absorption for capillarity rise test
Four bricks (two new and two original Cham) have been tested applying the water absorption by capillarity rise test, following the European Normal “UNI EN 772-11”.

This test on the new and original Cham bricks gave results which have been processed and compared (Fig.104).

![New bricks and Cham bricks](image)

Fig. 104– Water absorption for capillary rise on two new and on two old bricks.

The rate of capillary rise of the new bricks is definitely much higher than the original ones. They are in fact saturated in 24 Hour, while the original reach saturation in 8 days. Nevertheless the quantity of water absorbed at saturation by the last ones is around the 50% more than the one absorbed by the new bricks.

It is necessary to carry out some other test as: total absorption, IRS and porosimetry in order to make a complete comparison.

### 4.3.2 Remarks and suggestions

The deposit is heterogeneous:
- it’s not suggested the use of superficial clay because it’s full of organic material (Fig.105), dangerous for the structure of the bricks once they are fired.
-it’s suggested to use and mix a big amount of clay in order to have a homogeneous quality for all the produced bricks

The mixing of the clay is made by foot adding water:
-it’s suggested to extend the time of mixing, because at present the mixture is not homogeneous: some nodules of different colour and texture still remain. (Fig.106)

After mixing, the material is plastic and easy to mould.
The moulding of the bricks is made by throwing from a certain height the material in a wooden mould:

-it’s suggested a further pressing by a timber board in order to avoid the presence of macro porosity

The drying process is in the open air and bricks are put directly on a cement basement. After one day it’s visible a deformation due to inhomogeneous loss of water (Fig.107):

![Fig. 107–Deformation of a brick after drying period](image)

-it’s suggested to put the bricks on wooden fillets in order to have homogeneous ventilation on all the faces of the bricks

### 4.3.3 Remarks and requirements

**Control after firing:**
- the bricks must not have cracks;
- the edges must be complete;
- the faces must be parallel;
- the bricks must not have white stains on the surface (salts);
- the bricks must not have white pebbles (due to calcium carbonate).

Bricks must not be permeable to water (intending that the water can pass through only in a long time)

**Dimensions needed: 16x32x5cm**