REPORT ON TECHNICAL AND ON-SITE ACTIVITIES
CARRIED OUT FROM 1ST MARCH TO 30TH JUNE 2005
By arch. Dang Khanh Ngoc – Project Consultant

TENTATIVE SCHEDULE OF TECHNICAL ACTIVITIES

The first technical meeting has taken place in the expert house on March 5th in order to plan all the works and activities will be carried out in 2005. Participated to the meeting were International coordinator M. Cucarzi, P. Zoles, Prof. L. Binda (DIS. Politecnico di Milano), Mr. Phan Thanh Bao- the project’s National director and Dang Khanh Ngoc. A tentative schedule of architectural activities of the 2005 project year has been set up.

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General work

Checking by Arch. Dang Khanh Ngoc

| Technician | 2 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 4 |

Geometrical – Architectural survey. Requested number of technician.

Drawing processing. Requested number of technician.

Restoration work. Requested number of technician.
THE TECHNICAL ACTIVITIES HAVE BEEN CARRIED OUT UNTIL JUN. 30TH

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General work

| Technician | 2 | 3 | 4 | 5 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 3 | 4 |

Checking by Arch. Dang Khanh Ngoc

- **Yellow**: Geometrical – Architectural survey. Available number of technician.
- **Red**: Restoration work. Available number of technician (D: architects from DIS, Politecnico di Milano)
- **Blue**: Drawing processing. Available number of technician.
### The Updated Working Schedule from July 1st to September 30th

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<td>Temp. supporting</td>
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<td>Enclosing wall</td>
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1. PLANNING FOR THE ON SITE ACTIVITIES

From 6th, to 10th March, M. Cucarzi, Dang Khanh Ngoc together with Prof. Binda and collaboration staffs from Politecnico di Milano started the mission having a survey to the site. All the monuments of group G have been controlled to plan the future actions to carry on during the intervention of conservation. In 10th March architect Le Thanh Vinh, the director of Institute for Conservation of Monuments arrived from Hanoi visiting the site together with Prof. Binda and all architectural working group to finalize the planning for the onsite activities. The following observations have been pointed out. (According to the 10th Report on the architecture survey and research carried out from to 5th to 31st March, by L. Binda and collaboration staffs)

1.1 G3 - Mandapa

East side
- The work was very well performed, but it must be paid attention to the joints alignment, that must be not continuous: they must show an offset.
- The bricks in the corner should always be positioned alternatively header/side, also in the internal part according to the Cham technique.
- In presence of deep holes, cracks, etc, it is necessary to repair in order to prevent and to avoid progressive damages.
- Eventually, where the damage is even large, but not deep, it is not strictly necessary to repair it.
- In correspondence with east entrance, is necessary to rebuild the original shape in order to house the large sandstone step, at present displaced from its original setting.

**North side**
- This masonry is showing different type of pressures. In fact the masonry is partly missed and partly lost the interior filling, so that the outer leaves are free. In this case the conservation will be performed only to prevent collapses but not to perform a complete reconstruction.
- The stability of the wall will be ensured maintaining the present elevation profile.
- The base mould partly lost, can be repaired but not reconstructed. It is important to support the wall avoiding a fake reconstruction of decoration.

**North-West corner**
- The corner must be reconstructed in order to carry out the connection of the West and South sides.
- Also the mould can be built.
- The external and internal faces should be built where missing.

**West side**
- The entrance is in worst state. The connections between masonry elements seem to be lost and the leaning of the masonry must be taken under control.
- The sandstone step must be removed and its foundation frame must be verified and eventually repaired.

**West-South corner**
- The presence of the big dead tree embedded into the masonry is giving problems to the structure. The removal seems to be reasonable, but this will imply the total reconstruction of the corner.
- After removal the corner will be repaired following the general principles described above.

**South side**
- Also if the wall is leaning inward, all the material is still maintaining its original trend and location. The removing will be made dismantling course by course after the numbering of the bricks.
- Towards the South-East corner there are situations similar to the South-West corner, which will be solved by applying the same principles of conservation described above.

**Internal floor**
- According to the studies carried out by Patrizia Zolese, the original floor reached the threshold of the entrance marked by a step to enter inside. At present the original floor is missed and has been found the foundation made by a beaten surface of anthropic material.
A first proposal was to fill by soil until the original floor level. Due to the not uniform height of the wall, that in some parts are very low, it has been decided to put the floor slightly lower of the original one.

Proposals for exposed sections
- Horizontal surfaces should be finished by a course of bricks tied together with a very thin joint.
- For the vertical surfaces the filling between the two wall faces will be protected by bricks and bricks purposely shaped to avoid water infiltration that can produce erosion of this original filling.

Laterite layer at the bottom
- The basement of the monument is showing a row of laterite. Where laterite is missing it must be replaced with new laterite.
- Where there is a danger of settlements, new laterite can be forced under the bricks in order to make a supporting layer. This intervention must be done in subsequent steps in alternate positions.

Reconstruction of the North-East corner
The reconstruction of the corner, started during last season, is going on, following the principles of anastilosys techniques. Existing detached bricks are dismantled, after the survey of each element, and replaced in the correct position.

Scaffolding
The provisional covering built last year to protect the building from the rainy monsoon season has been dismantled. This decision was taken to avoid dangerous influences of the roof on the masonry during this period, characterized by hot temperature and wet climate.
A covering has been built on the masonry of the North-East corner to protect the workers and the structures during the execution of the intervention.

1.2 POSHA G5
The survey continued to Posha G5. The restoration of this building does not seem to be very difficult. Only few courses of the original walls are still standing. After excavation by the archaeologists the floor will be filled again and the work will be started by repairing the remained courses. The bricks to be used are quite in place.

1.3 GOPURA G2
This building is very badly damages with partial collapses near every corner and large pieces or piers of wall standing but not very stable.
The restoration approach, as for the other buildings, will be to preserve as much as possible. It will be tried to reposition and fix the large remaining portions of walls which are now cracked and dislocated. Attention will be paid to the possible reconstruction of the entrances. When and if possible the stone frames of the doors should be repositioned.
1.4 TEMPLE G4

**Consideration on the use of herbicide on the trees**

The treatment made by poison gave good results. The injected trees died and the poison did not have any negative result on the surrounding vegetation.

**Conservation strategy for the building**

The main problem for the building is the exceptional number of trees grown inside the walls. It has been decided to dismantle one leaf of the wall in contact with a tree root. The tree was already treated with herbicide bullets during the past season. Being the extension of the roots not deep, and the trunk no more alive, the trunk was cut off and the remaining alive roots treated again by poison. In this first case only a small part of the wall has to be repositioned again. The operation will be repeated step by step carefully everywhere in G4 in order to avoid invasive interventions.

*Fig. 5 - Real condition of Temple G1 in 1st March*
2. GEOMETRICAL SURVEY OF THE G - GROUP

2.1 Geometrical survey of G1 (According to the 10th Report on the architecture survey and research carried out from to 5th to 31st March, by L. Binda and collaboration staffs)

The geometrical survey of temple G1 has been carried out by L. Cantini and P. Condoleo (DIS, Politecnico di Milano) in March.

Phases of the work

Considering Temple G1, the most preserved among the other structures, it is possible to identify three main bodies of the building:
- the basement, until 1.35 m height overlain by a layer of laterite;
- the main body of the temple, characterized by the entrance and the cella;
- the roofing of the temple, that is totally lost. It is possible to recognize only few elements at the end of the main facade which introduce a geometrical decoration with a horizontal development that represents a gap between the main facade and the roof of the temple.

Recognising these elements, it was possible to plan a correct survey using the total station. To represent this complex geometry, it was not possible to build a polygon of points for one level of the building. In this case the difficulty of the 3D representation of the different levels of the monument required a strategy that is summarized in the following steps, describing the survey carried out on the basement.

The first step was to make the survey of the basement profile, where the monument preserved the original development of the external decoration.

The second step was a geometrical 3D model representation, of the basement, drawn by AutoCAD.

The third one was the survey of the main lacks on basement surfaces. To perform the survey, an ortho-photographic documentation of each part of the basement has been taken. By the picture was possible to define and to locate the perimeter and the depth of each lack. This documentation has been drawn back in a correct scale by AutoCAD program. The representation provides a 3D model of the basement of the present day state of conservation.

As final action, the total station (Fig.6) was used to control the development in the space of the main elements of the building. Some points were taken by the total station vertically, on the external profile of the basement, twice for each side. This strategy permitted to define the correct position of each different plan which composes the geometry of the basement and to verify the linear measurements.

This procedure was applied also for the other levels which compose the building, in order to obtain the correct horizontal section of each level. The final result of the described procedure is shown in figure 7.
Scaffolding

Scaffoldings, built to prevent possible collapses of the structures during the monsoon season, have been removed. A new provisional structure was built to save the new excavation near the leaning wall of the main stair of the monument. (Figs 8, 9)

2.2 Geometrical survey of G4 (Mar.15 – May15)

The geometrical survey of G4 has been started since March 15, right after the on site activities plan was issued. The survey was carried out by 3 Vietnamese technicians and draftsmen. All of the monument’s elevations (8 sketches), main plan and two sections have been sketched in scale of 1/10 on millimetre paper. The work taken almost 2 months, completed in around May 15.
2.3 Geometrical survey of G5 (Apr. 1 – Apr. 30; May 16 – May 20)

In order to have the whole geometrical data of G5 before starting of conservation phase, the survey of the G5 has been continued in April based on the drawings have made in 2004. In the end of May a foundation test has been taken to clarify the structure of the building in order to get the right decision of intervention. The last three brick courses of the foundation were exposed requesting to be added to the final survey’s result.
2.4 Geometrical survey of G2 (May16 – May27)

When the geometrical survey of G4 was finished, the next survey has been taken place Gopura G2, the main entrance lead to the sacred courtyard. Four Vietnamese technicians have carried out the survey in two weeks including 7 hand drawings in scale of 1/10.
Fig. 17 – A particular remaining masonry

Fig. 18 – G2 South-west prospect

Fig. 19 – G2 general plan
2.5 Geometrical survey of E7 (Mar.10 – Mar.31; May30 – going on)

The geometrical survey of E7 had started since the beginning of 2004 project together with preliminary study on crack pattern survey. All the survey results of last year have just arrived to the level of the roof’s edge due to the lack of sufficient scaffolding. During March 2005 the survey has been continued in order to complete whole monument’s geometrical data. Again in late of May the survey started to go deeper in detail in order providing the data base for the cooperative project will be executed next year.
3. TYPOLOGICAL AND DAMAGE SURVEY OF THE BUILDINGS

The evaluation of typological characteristics and damages of the monuments in My Son was started last year and now is going on by a deeper study of the vulnerability of the buildings. This analysis is based on specific voices contained in a card for the building description. This work is carried out by M. Core (DIS, Politecnico di Milano).

4. STUDY OF THE BUILDING TECHNIQUES USED IN THE TEMPLES

While surveying the buildings of G - Group, the analysis of the construction techniques, started last year, is going on by architects from DIS. By the cleaning of the materials collapsed inside G1, it was possible to study the characteristics of the brick connections used for the masonry. The analysis was focused on the particular shapes given to bricks.
5. CONSERVATION THE MANDAPA G3 (Started in Mar. 11)

Since the beginning of the new work season in My Son, many on site activities have been controlled by the architects of DIS. In particular Condoleo, Core and Dang Khanh Ngoc were checking the reconstruction works in G3, controlling the correct development of the work according to the principles of the design.

5.1 Fixing of North-East corner (March 11 – May 15)

The fixing of the bricks of the North-East corner is started on following the procedure decided last year. First of all, bricks are numbered, cleaned by air compressor and then fixed by a thin joint of natural glue (Figs 28, 29)

![Fig. 28, 29 – Temporary brick marking](image)

When the glue has been dried, is possible to continue fixing the internal part of the wall by mortar, composed of lime and different sizes of brick powder, and broken bricks.
The fixing of the bricks of the North-East corner is following the technical solution mentioned in the plan; also the loosing original bricks which are without original joint have been replaced by gluing with the natural glue.

The restoration works the North-East corner has been finished in 15 of May; the covering layer was decided to be done in all over the G3 wall in the end of conservation phase.
5.2 North side (Started in March)

During March the preparation phase of consolidation work along the north side of the Mandapa is finished. The bricks of the vertical structures have been numbered, dismantled, cleaned and temporary replaced in the original position. The internal filling was cleaned out to permit the removal of trees and roots.

In the adjoining part of the north-west corner, the dismantling work was carried out deeper than in the other parts due to the presence of a much damaged masonry. This situation allowed performing an inspection to the laterite layer under the wall. It was found that the laterite foundation crosses the masonry section.

The fixing phase of the bricks made by resin and mortar on this side of the wall is almost finished, at the end of May only few courses of bricks in the adjoining part of North - West
corner are still to be fixed. These bricks have to be fixed together with the prepared bricks in corner in order to get well connection and homogeneous masonry structure.

5.3 North - West corner (Started dismantling in April 18)

The presence of this corner was shown in extremely damage, most of original bricks are loosen and remain in bad condition. A fully dismantling has been decided in order to comprehensive consolidate the masonry from its foundation. The strong damaged laterite blocks have been replaced by the good original ones which were found in the collapses during excavation. The reused laterite blocks were precisely prepared in sizes before installing to the right position in order to stabilize the corner masonry.

They have been fixed by a thin joint of mortar composed by lime and thin brick powder.
The reconstruction of the North-West corner masonry is still in progress. The reusing bricks were selected and prepared carefully before positioning in order to get a good observation of brick joints.

In the North-West corner the dismantling work went deeper due to strongly damaged presence of the masonry; an inspection to the laterite layer under the wall was performed. The texture of laterite here looks seem to be laid out of the wall. During the inspection there was a brick layer under the laterite layers was found. These layer composed by brick in bigger sizes compared with common original bricks (cm 30 x 15 x 8.5), much heavier in weight and in dark red colour. It is able to say that these bricks were made by another material and they were fired by different technique and were reused.
In June there were steps with three brick courses each has been built up together with the West side wall, which almost has been fully dismantled. The final profile of this corner is still carefully considering in order getting a good image.

5.4 West side

The consolidation work is proceeding along the west side of the Mandapa. Here to allow the dismantling of the wall, the stone threshold has been removed and it is temporary laid inside the monument. After the fixing of this part of wall the stone will be replaced in its original position.

There was a very big root of a tree, which was killed and cut off some year ago, located in the wall close to South-west corner. Its diameter about 50cm and the root’s branches are still
remaining very deep in the ground. A fully dismantling has been decided in order to remove the root thoroughly.

The reconstruction started by replacing laterite blocks which were strongly damaged or deformed. The new laterite blocks are produced by the average size of 38 x 22 x 9 cm, they were cut and ground again before putting in place in order to fit to the original ones. The masonry restoration in the West side is going to complete shortly.
5.5 South – West Corner

During the cleaning of the wall two bricks of a special square shape have been found at the foundation level of this corner. Some decorated bricks have been found both in the foundation level both in the internal layer of the wall.

The internal has been dismantled and all the tree roots and the soil have been removed in order to replace the bricks in their original position and to fill all the missing with other original bricks which are selected from the excavations of the collapses.

The preparation of the reconstructed masonry has been taken over June. It is now going to be fixed by resin and mortar by steps of three courses each.
5.6 Tree and infesting vegetation removal

The removal of trees grew into the building masonries is going on. The trunk into the south-east corner of G1 has been cut. (See 5.4 West side of G3)

Other roots emerged during the dismantling of the north side masonry of G3. The roots have been cut and injected by herbicide bullets.

Fig. 60, 61 – Three kinds of herbicide to kill tree roots
Fig. 62 – Capsules injected to the root
5.7 Collapsing removal

After cleaning infesting vegetation and rubble materials, consistent pieces of structures have been cleared. Very large masonry portions have been found into the collapsing along the north side of G1.

The bricks of the collapsed wall portions have been numbered to allow a precise reconstruction in a free area of the site. The aim is to study the original profile of the external wall in order to understand the original development of the mouldings.
6. **STORAGE OF THE COLLAPSED MATERIALS**

The opening of new excavation trenches on the site increased the number of the rescued materials found in the ground. It was necessary to set new storerooms for the conservation of the bricks. All the rescued material found during the excavation has been storage in storeroom that was built in the year 2004 close to G Group area.

All bricks have been cleaned by brushes and classified according to these characteristics: origin, size, surface features and reuse.

![Fig. 65 – Removing bricks](image1)

![Fig. 66 – Cleaning bricks](image2)

![Fig. 67 – On-site temporary store shelters](image3)

![Fig. 68 – Classify bricks in store room](image4)
7. **PREPARATION OF MORTAR**

Mortar used inside the wall of G3 – Mandapa was made by lime and brick powder in the following quantity:

Lime: 1 kg

Brick’s powder: 3 kg divided in

- a. 405 g made by 0,008 to 0,16 mm
- b. 1620 g made by 0,5 to 1 mm
- c. 975 g made by 1,6 to 2 mm

Prepare the brick powder in order to get good quality of mortar following laboratory test suggestion:

+ Selecting broken bricks
+ Breaking and grinding
+ Sieving according to the required sizes

The process of mortar preparation:
+ Weighing dry materials according to the requested composition
+ Mixing well dry materials
+ Adding reasonable quantity of water in order to get the most sufficient mortar
8. RESEARCH OF NEW COMPATIBLE MATERIALS

Considering the technical suggestion following the lab analysis it is necessary to use new materials which have compatible characteristic with original ones in order to get a homogenous masonry’s structure.

There are several visits were taken place in which used to and or have been produced the materials which are necessary for conservation work.

8.1. Brick

To complete the consolidation and the reconstruction of the ruins, the rescued bricks coming from the collapsing are not sufficient. Many of those bricks can be used for the internal filling of the masonry due to their surface characteristics do not satisfy the requirement of the surface exposure.

The first visit in March 22 was aiming to find the brick factory which has been used to produce brick in traditional artisan method. The visit has taken place in three points closest to My Son, which considered the most common and well known producers locally. Unfortunately all of these producers have been closed for years because of uncompetitive in trading with the industrial products.

According to the local legend there is one squared-shape pond in Duy Phu village, which is 3 km far from the site, where the Cham people used to quarried clay for production of brick in the ancient time. A short visit has been taken in order to take the clay sample sending for lab analysis.

![Fig. 73 – The legendary square-shaped pond](image)

![Fig. 74 – Clay samples for lab analysis](image)

By the urgent situation of the new brick, which needs for restoration work of the monuments, there was a decision to prepare on site test of reproducing brick. The brick samples made by local artisans with material taken from the legendary pond after firing have been submitted to the test on water absorption due to capillary action carried out right in the expert house.
8.2. Lime

In the other side the using of lime are requested a kind of lime which is hydraulic or natural hydrated following the lab suggestions. In 12th of March the first visit was taken by Patrizia Zoles; Manuela Core and Dang Khanh Ngoc. The first visiting place was Lang Co, a small village located along the shore of Lang Co lagoon, about 50 km away to the North from Da Nang city. Till now here is the biggest place of producing lime from shell taken from the lagoon. By the naked eyes observation it was easy to see that the quality of limes produced here is very poor. In fact nowadays most of these products are used for agriculture purposes such as improving soils; manuring rice field or purifying water for aquaculture. A small quantity of sample has been taken in order to take chemical analysis in labs.
The second visiting place was Non Nuoc village, a very famous place in producing products of natural stone taken from mountain range of Ngu Hanh Son, which is 15 km away from Da Nang. In the past there was a biggest limestone kiln there but since three years ago for the reason of protecting the landscape the provincial government of Da Nang strictly forbidden to cut the natural stone for any purposes.

The next place has been visited was a lime store which located in countryside of Hoi An ancient town. The lime are sold here is made from shell taken from the river. This is the only one provider of shell lime for building purpose all around Hoi An nowadays, especially for restoration of old buildings have been carrying out in Hoi An. Therefore the quality of product in this place is much higher than in Lang Co. Samples have been submitted for chemical analysis in lab also.

Two samples taken from the visit were sent to chemical lab of Institute for Conservation of Monuments in Ha Noi, together with other sample of natural hydrated lime, which is used commonly in Ha Noi and the surrounding area.
8.3. Laterite

In April 22, another visit has been taken by Mauro and Pierre Pichard and Dang Khanh Ngoc in order to find the new compatible of laterite, which will be used to replace the broken in the foundation of G3 also for consolidation the laterite enclosing wall. The visiting site located in a village which is about 20 km away to the south from Tam Ky town, 90 km far from the site, there are here large amount of laterite quarry. The inhabitant living around this area is still using laterite to build houses nowadays. The laterite bricks were cut from the open-cast quarries by the common sizes of commercial product of 25 x 16 x 11 cm.

Fig. 83 – On site testing of shell limes

Fig. 84 – New laterite sample