United Nations
Educational, Scientific and
Cultural Organization

World Heritage Convention

Umm er-Rasas

Jordan

28 June – 8 July 2008

Restoration of the Stylite Tower

Mission Report

Architect:
Davide Sicilia

INTRODUCTION

This mission is part of the framework of technical assistance for the funding by the Italian/ UNESCO Joint Declaration on Co-operation, upon invitation of the Jordanian authorities and in collaboration with the World Heritage Centre.

David Sicilia Architect and UNESCO Consultant awarded the support of the Departments of Antiquities (Ministry of Tourism and Antiquities) and the UNESCO office in Amman.

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1-SCHEDULE OF THE MISSION

The mission took place according to the following schedule:

28 June	Arrival of David Sicilia, UNESCO Consultant, in Amman.
29 June	Meeting at the Department of Antiquities with Dr. May Shaer, Responsible for restoration project at the DoA, and Dr Basem AL-Mahamid, Archaeologist.

	Meeting with Dr.Fawwaz Kraycheh, the Director-General of DoA. And Dr May Shaer.
	Meeting with Mrs Tamara Teneishvili at the UNESCO office in Amman.
30 June	Visit to Umm-er-Rasas with Dr. Basem Al-Mohamid, Archaeologist and Mrs Nadia Okasha, Engineer and Jamal Safi, architect being in charge whit reading measures of the tower.
	Visit to Madaba.
	Meeting with Dr May Shaer.
1 July	Visit to Umm-er-Rasas with Jamal Safi in order to start the reading of the measures and carry out the first estimate of the tower deformations.
	First excavations at the level of foundations.
	Pictures of the monument
2 July	Visit to Umm-er-Rasas with Dr. Basem Al-Mahamid and Jamal Safi to establish the methodology of the measurs' reading and carry out the excavation at the foundations.
	As-built drawing of foundations.
	Detailed pictures of facades.
	Meeting with Dr. May Shaer to discuss about the situation.
3 July	Meeting at the DoA with Mr Moh'd Ali Al Katib, Architect (who has worked on the propositions of restoration of the tower).
	Visit to the tower with Basem Al-Mahamid, Mo'd Ali Al Kati and Jamal Safi.
	Visit to the Citadel of Amman and the Roman theatre and Odeon.
4/5 July	Visit to Petra

6 July	Drafting of the mission's report of and the investigations' schedule.
7 July	Meeting with Dr May Shaer, Dr Basem Al-Mahamid and Jamal Safi at the DoA for presentation of the first proposals for investigations in order to draft a restoration project of the tower.
8 July	Departure to Paris of David Sicilia UNESCO Consultant.

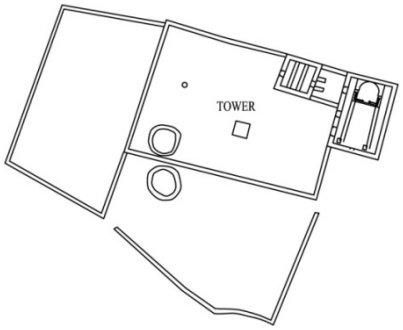
2- VISIT OF THE STYLITE TOWER

2.1- LOCATION AND ACCESS

On June 30 the first visit of the stylite tower has been carried out together with the team of DoA. We immediately noticed that the tower is 1.5 km from the new visitor centre on the site: therefore it is exactly the opposite of the Castrum complex and the church of Saint Stephen.

You can access the tower and the walls of the religious complex by a dirt road which leads to the limit of perimeter of the site. The ruins of the church which are in front of the tower were restored (this restoration mask the main entrance of the church located on the west facade).

It has been remarked that the tower is located almost in the middle of the precincts of the complex and that undoubtedly in the past one should pass through the church order to access to the tower perhaps in order to preserve the solitude of the saint.

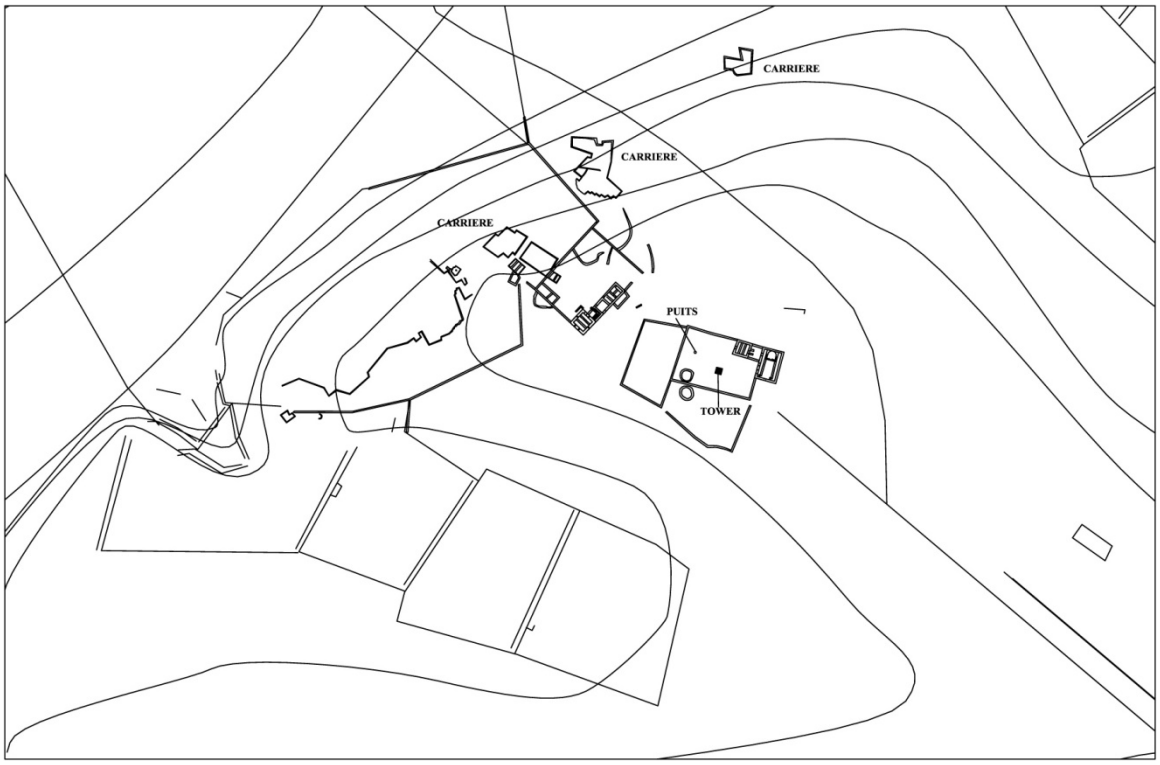


2.2- BACKGROUND

The complex stylite tower and its church is located on a very rocky ground. The buildings are based directly on the rock. This land, sloping to the north, also presents a number of quarries nearby the buildings. The quarries were used in their construction.

Sometimes, as in the case of concerned area, the quarries, after their exploitation, have been used as reservoirs for water gathering. A well is located not too far from the tower and it is likely that galleries exist in the ground.

The tower is located in a very ventilated site and can actually remark on the north side the erosion of rocks caused by wind and rain. We draw your attention to the fact that the area of the site is a seismic zone.



SITE MAP OF COMPLEX OF THE STYLITE TOWER

We have noted the presence of quarries and wells in the nearby of the tower

3- DESCRIPTION OF THE TOWER: CONSTRUCTIVE AND STRUCTURAL ELEMENTS

3.1- GEOMETRY - DISTRIBUTION

The tower, which has a square base, is composed of 30 rows of blocks of carved stone, which poses a ridge which is the basis of the higher *cella* . This *cella* is formed by 5 rows of stones and a top cornice. At the angles of the tower, the stones are carved into semi circular shape to form half-columns. The top cornice presents moldings and has sculpted capitals in its angles. The cell has three openings, among which the greatest one stands on the south side. The *cella* was covered with a stone dome which appears today collapsed on the ground.

The stone blocks are linked by mortar joints, which for three quarters of masonry, are non-existent.

At the base of the tower, on the north side, there is an opening through which one reaches a niche, perhaps once vaulted. In the north-west corner, inside the tower, there is a square and vertical gallery, which served as a liaison with the *cella*. One possible explanation for this gallery is that the pilgrims, after having passed through the church, could communicate with the saint by this gallery asking him for prayers and giving him offerings. This gallery with a width of 45 cm by 45 cm is blocked at the 17th row of stones, probably after the fall of stones of the dome.

The distribution space in the tower was very simple: at the basis of the tower a small space (may be vaulted, in order to accommodate the pilgrims), a vertical gallery to communicate with the upper part and a *cella*, instead of saint (formerly vaulted).

SOUTH FACADE

EAST FACADE

WEST FACADE

NORTH FACADE

Opening at the basis of the north side

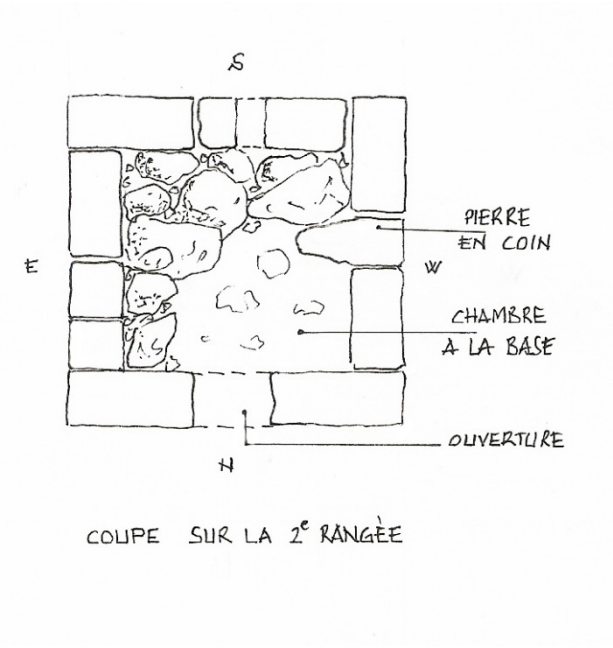
Inside the base of the tower

VERTICAL GALLERY

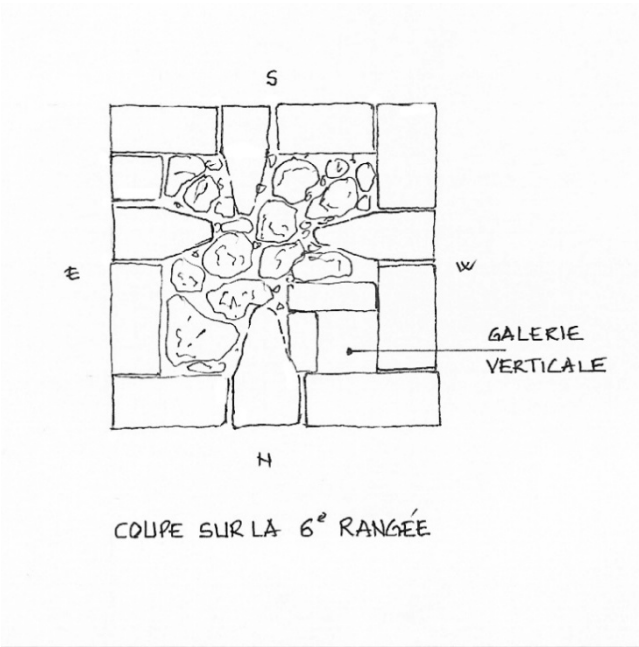
VERTICAL GALLERY OBSTRUCTION AT THE CELLA

3.2- INFILLING

The tower has a square base sides of 2.50 meters. The stones of the outer perimeter are regularly cut and well matched. In its interiors, the tower is filled in all its height by irregular stones; one can see occasionally larger stones laid on their straighter side. It is likely that each two or three rows narrower and longer stones exist. These stones, located in the middle of the row and having an end with a cone-shaped (arch stone shape), are designed to block the assembly and the inside infilling. This could be confirmed by an as-built drawing which will be made on the spot shortly.



COUPE SUR LA 2e RANGÈE



COUPE SUR LA 6e RANGÉE

The design of the 6th row shows rocks arch stones; this is a hypothesis to be verified by further investigations. The arch stone of the 2nd row is present.

MASONRY INTERIEUR
The interiors joints are hallow

INSIDE THE BASIS OF THE TOUR
A stone face is cut so as to stabilize the filling.

3.3- THE FOUNDATIONS

The tower lays directly on the rock. Excavations have been requested at the north, east and west sides. One can notice that the first row of the tower base rests on carved stones being more than 40 cm tall. These foundation stones are supported on the rock and, despite the superficial poll one may imagine that in some places the rock was directly carved to form the basis of foundation. It would be necessary to carry out further surveys and cores ground near the foundations in order to assess the composition, internal consistency and compressibility of the ground.

WEST FACADE

Superficial excavation: the rock is located 40 cm underneath.

WEST FACADE

One may note the presence of the rock at the base.

NORTH FACADE

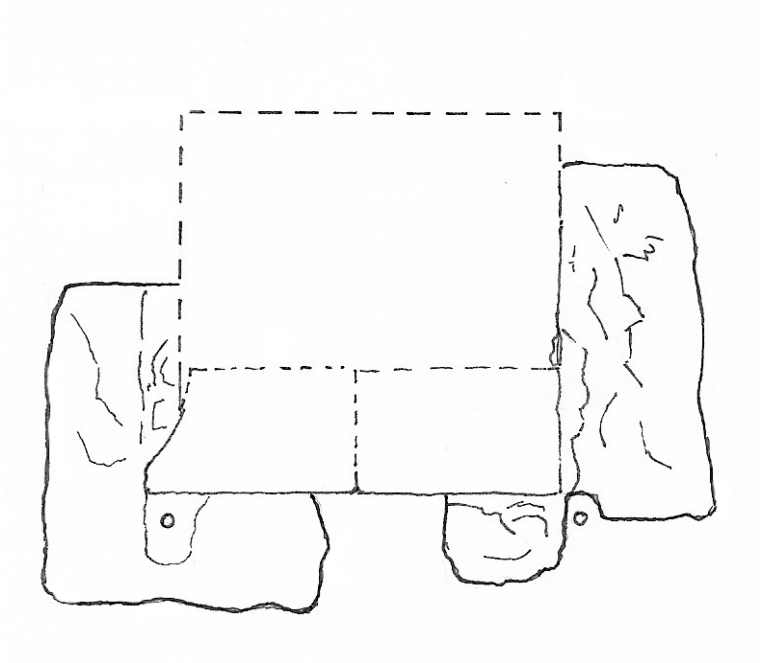
The north-west angle represents the direction towards which the tower is poured.

NORTH FACADE

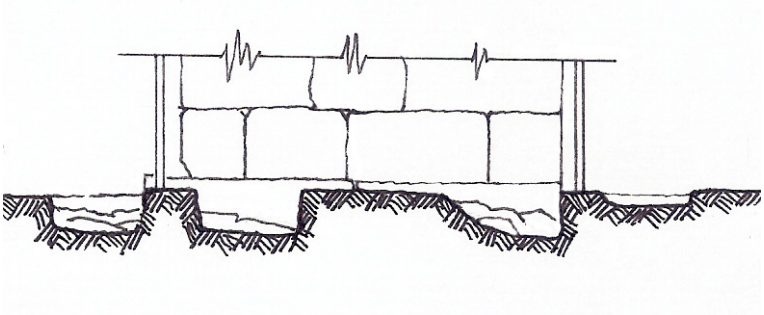
Nord-est angle : the base stone is a long stone of 1, 35 meter long.

EAST FACADE

North-East angle: the rock is levelled at the lower level of the tower.

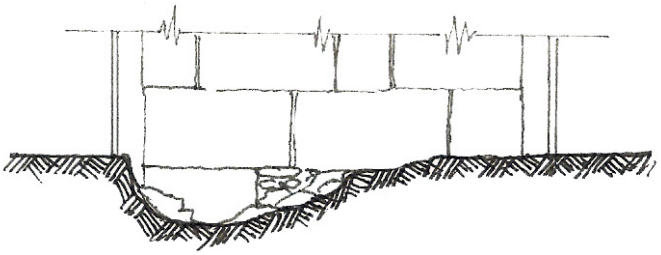


BASIS OF FOUNDATIONS OF THE STYLITE TOWER
Location of the excavations



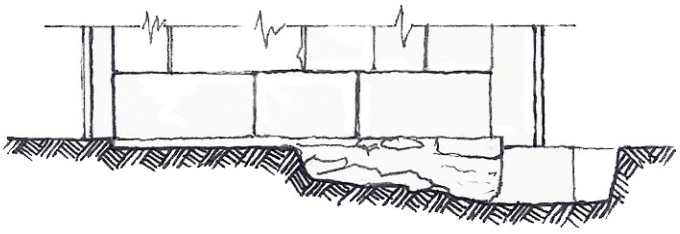
NORTH FACADE

Cross section to the ground foundations after excavations.
Two large blocks of stones are the basis at the first row of the tower



WEST FACADE

The stones on the first row are based directly on the rock



EAST FACADE

4- CONSERVATION STATUS

4.1- MATERIALS

The blocks of carved stones which make up the tower come from the quarries located 50 m further north. The majority of the stones are in very bad conditions of conservation. The joints between the stones are largely bleached and the mortar is non-existent. The movement of the tower has resulted in a shift of the stones and a loosening of the joints.

With the exception of the eastern facade, which presents only problems in its lower part and at the level of the *cella*, one remarks various issues on the other facedes:

- Cracking of the stones: simple cracks and compounded cracks;
- Erosions of the stones are present mainly on the northern facade due to prevailing winds and heavy rains;
- Lack of the joints on all surfaces;
- Total lack of some stones.

Within the tower, the filling stones, when one can see them, have not the joints: they seem to be juxtaposed, but they seem to slide over each other leading to a movement in the direction of the north-west angle. The vertical gallery is located at the interior of this angle and is a very weak point of the structure of the tower.

Without doubt the most damaged part of the tower is the *cella*. We assume that the *cella* was covered with a stone dome which has collapsed on the floor of the *cella* (as we have found on the floor the arch stones). This collapse has led to an opening slot in the central parts of the facades and in the rows below the lower cornice. The stones came out of their beds and the joints are non-existent. The cornices and the upper lintels are very eroded and decorations and sculptures are in a state of advanced deterioration. Some stones have lost their original form and present an evident and future collapse.

The lintels of the bays of the *cella* are non-existent, very eroded and broken in two pieces. Several stones and parts of the high ridge are missing.

NORTH FACADE – Cracked stone.

NORTH FACADE - Eroded stone.

SOUTH FACADE

Spacer joints at south-east angle.

SOUTH FACADE

Broken stone at the basis of the tower

SUD-EAST ANGLE

Slippage of stones in 7 rows

INFILLING INTERIOR

The mortar is non-existent

INTERIOR EAST FACADE

The majority of the stones are eroded. The lintel is broken.

INTERIOR NORTH FACADE

A very eroded stone in a state of collapse.

NORTH-WEST ANGLE

The decor of the capital is erased by erosion.

WEST FACADE LINTEL

ANGLE SOUTH-WEST ANGLE

Slippage stones

CELLA

Arch stones coverage of the dome

4.2- ACTIONS OF DEFORMATIONS

We draw your attention to the following issues:

- As we know, the stylite tower lies on a bedrock sloping to the north. The rock was used for the construction of the tower and its religious complex; the quarries are very close to the lower part of the rock.
- The system of construction of the tower is very pecul iar. The matched stones of the exterior walls contain, a filling of stones as a bag. In addition, the North West inside angle is empty throughout the height of the tower and is a weak point for the stability of the structure.
- We know that a on 779 AD, there was a strong earthquake occurred in this area.

All these circumstances surely contribute to the appearance of various distortions in the structure of the tower.

Of the four facades one can remark, the loosening of stones and the appearance of cracks located on the total heigth.

The main deformities are as follows:

- Separation of the tower over the south-east corner, from the base to the 7th row.
- Inclination of the tower in the opposite direction, north-west.
- On the northern side the majority of cracks and of the loosening stones is present on the total height of the north-west angle, at the level of the vertical gallery.
- Collapse of coverage of the *cella* which has resulted in several than breaks on the cornice above and lintels berries.
- This collapse caused spills walls of the cell and the consequent shift of the stones from their beds.
- The inside infilling has suffered from the shock of the collapse and the increase of the burden has caused a very important deformation. This deformation accompanied by a lack of mortar, has been shown as a shift towards the lowest point, i.e. the vertical gallery in the north-west corner.
- The erosion of stones, especially on the north side, is very important, some of the stones have lost several centimetres in thickness and the stones lying at the *cella* have changed their geometry.

All these distortions exacerbate the instability of the stylite tower already very precarious. In particular a simple seismic motion, or an increase of the current erosion may lead to the collapse of parts of the masonry (walls of the cell) or of the tower (generalized collapse).

4.3- SCAFFOLDING

The tower is surrounded of scaffolding for more than two years. This metal structure with corridors in planks of wood, is in very poor condition for various reasons:

- Support of the scaffolding on the ground directly on the ground without crossing distribution.
- Vertical tubular structure on the scaffolding without wind braces, tubes diagonals tubes lack of the four facades across the height.
- The wooden corridors are not protected and they often lack of the wooden planks to cover the entire width of corridors. Several boards are cracked. The corridors in several place are not adjacent to exterior walls of the tower but at a distance between 50 and 70 cm (very dangerous situation), no protection is assured.
- Lack of safety net.
- At the *cella* level the scaffolding stops at 1.50 m from the lower ridge, so there is no umbrella roof of protection for the upper part of the tower.
- Only the stairs to the corridors is more stable (presence of diagonal bars, wooden planks are framed in metal structures).

In general, this structure presents many weak points with respect to its stability and especially to the protection of workers. It should be underlined that the site is not protected against the intrusion of non authorised persons.

It is necessary to dismantle the scaffolding and rebuild it according to the rules of art and by putting in place protective measures.

SCAFFOLDING

No diagonal tubes to stabilize the structure.

The wooden corridors do not cover the entire width

They are superimposed without any fixation.

5- PROJECT OF INVESTIGATION

(Prior to the restoration of the stylite tower)

The restoration project of the stylite tower cannot take place without a good study of complete and thorough investigation. Various studies have already been made on the tower and various information were provided. It is necessary to take stock and push the investigation by also using the information gathered so far. With an aim to establish a good restoration project, the investigation file will have to address the following matters:

5.1 KOWLEDGE OF MONUMENT

- HISTORY

  The gathering of all historical information (according to the ancient and new studies) is necessary to better understand the monument, its functions and its transformations.

- PHOTOGRAPHY

  The old pictures are already in the archives of the Departement of Antiquities (DoA).

- GEOMETRY OF STRUCTURALS DETAILS

  An as-built drawing drawn on DWG format has been requested. In particular the DoA has no designed plan of the tower. The as-built drawing will consist of 4 facades, 2 vertical cuts, at least 6 horizontal and various details (foundations, interior structure, etc.)..

- DEFORMATIONS

  O the basis of the above-mentioned statement it will be much easier to assess the various deformities of the tower, its inclination, the width of the cracks, the opening up of the joints in various parts of the tower. It will be easier to view directions cracks for a consistently good reading and analysis.

- CONTROL OF THE CRACKS

  It is also advisable to control the cracks with the adapted instruments on different parts of the tower (weak points) in order to calculate the speed of the deformities.

5.2 STUDY OF MATERIALS

- STONES

  The knowledge of the constitution of the stone is necessary to deduct its mechanical properties and especially the limit of resistance.

- JOINTS

  Some laboratory tests will lead us to better know the composition of the mortar.

5.3 STUDY OF LAND AND FOUNDATIONS

- CORING SOIL

  It is necessary to provide a core of soil in the vicinity of the tower to know its constitution and its properties. More important excavations will be made at the base of the tower in order to check the status of the foundations across the perimeter. The south-east angle(to a height of 7 rows) presentsi a detachment of stones; it is necessary to evaluate whether a settlement or collapse of the foundation took place at that location.

- GEOLOGY

  The geological maps of the site will have to be included in this file. This will let us know the morphology of the location.

- EVALUATION OF STABILITY OF THE FOUNDATIONS

  In order to assess the stability of a foundation it is necessary to know certain characteristics of the various layers of ground. These features will be deducted after laboratory examinations on samples taken with the test. They are as follows: Specific weight absolute; Specific weight apparent; Quantity of water in the dry state and the state natural; Porosity; Limits consistency (liquidity, plasticity, withdrawal); Cohesion; Compression; Compressibility; Permeability.

  All these characteristics contribute to the check of the stability of the land on which the vertical loads engrave.

5.4 SATTE OF EMERGENCY

It is absolutely necessary to establish emergency measures.

- THE SCAFFOLDING REMOVAL

  The existing scaffolding is obsolete. The new structure will be screened with wider corridors on which the worker can work without difficulties. It will have the wind braces to ensure greater stability and more attention shall be put on to the protection rules.

- SHORING OF THE TOWER

  If necessary, the new scaffolding will be built with a double purposed. It may also serve as temporary shoring of the tower by taking measures being appropriate to this situation (shoring against the facade of the west or north-west angle in order to oppose the dumping in this direction).

- FILED FOR THE STONES CELLA

  As we know, the most critical part as regards the stability of masonry is the *cella*. For security reasons the stones must be lifted and numbered. The stones which formed the coverage should be removed.

  This coverage may be rebuilt in a room of the Visitor Centre and leaned agains a structure made with other materials. In this room, directory signs will show the history, the use, construction, deformation and restoration of the tower.

  It is also advisable to lift two or three rows of stones below the lower ridge of the *cella* in order to know the modalities of building of this monument (filling, central stones with conical end, equipment of the stones of the vertical gallery, links between stones, etc.).

  The lifted stones being in a good state of conservation will be delivered back to their seats, while the ones which have lost their form will be replaced by new stones.

  At this stage it is necessary to put an umbrella roof on the scaffolding and, later when drafting the project, to think about the retirement from the water of the upper part of the tower.

5.5 ANALYSIS OF INFORMATION

All the gathered information will be analyzed by a team composed of various experts: architects, surveyors, geologists, engineers (research department).
This team will be headed by the DoA and will provide the report will include the diagrams and the drawings before and after the deformations.

We underline that DoA is already provided with such skills.

6 RESTAURATION PROJECT AND CONCLUSIONS

The willingness to solve the structural problems of the stylite tower is clear. The various experts appraisals have pointed out some urgency. Indeed it is true that a restoration project must be completed and put into action as soon as possible.

Both the Department of Antiquities and UNESCO work in this direction. Therefore Tthis present mission intend to draft a previous a specifications to the restoration project the several skills, knowledge and providing of international assistance in similar cases, will be useful to make the restoration of the stylite tower a methodological prototype program which could be applied on other projects.