**IMTO – Italian Mission to Oman** 

**University of Pisa** 

**SUMHURAM** 

**Preliminary Report** 

July 2009 (SUM09B)



# ARCHAEOLOGICAL PRELIMINARY REPORT (SUM09B)

# **July 2009**

The second IMTO's campaign of 2009 (SUM09B), directed by Alessandra Avanzini, started on 04.07.09 and finished on 23.07.09.

The main goals of this campaign were focused on excavations inside the Monumental Building 1, in area F, in area E (eastern side of the settlement -isolated tower and modern staircase-) and on restoration of wall M281, the last to be completed in the north-eastern sector of the city wall.

The excavations were conducted by dr. Said al Mashani, dr. Alessandra Lombardi and dr. Alexia Pavan.

Dr. Said al Mashani was responsible of the working operations in Sumhuram; Arch. A. Massa has been responsible of the topographic survey.

The consolidation and restoration of the ancient masonry structures have been done on the field by Said al Mashani and Alexia Pavan.

The work of IMTO has been possible thanks to the collaboration of the Office of the Adviser of His Majesty the Sultan for Cultural Affairs in Muscat and in Salalah. In particular, we would like to thank Ghanem al Shanfari, Said al Mashani, Said al Salmi, Hassan al Jabri and all the Museum's team for their kind helpfulness.

Salalah, 23 July 2009

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# 2. Restoration and Consolidation Activities – Technical Report

# Area A, Monumental Building (MB): works performed during the season and general considerations (Trench supervisor: Alexia Pavan)

The campaign carried on during the three weeks of July (figs. 1-2), although short, let us to confirm the existence of two big constructional phases of the MB with quite numerous different works concerning maintenance and rebuilding during the long occupation of the structure.

The soundings carried out in some parts of the court of the building let us to clarify some issues as well as the floors of first phase, the first paved floor of second phase and the foundation of M18.

Excavation (see sketch n.1)

The work in MB started with the removal of the structure built southern from the huge stone basin connecting the well (M300) with the channel, namely US329. This structure was, without any doubt, a later addition, to be linked with the last phase of occupation of the site (KRIII). The shape was roughly circular with a diameter of 1.2 m *circa*. The upper elevation was 27.74.

It was delimitated by roughly dressed limestone blocks, insisting on US264floor (elevation 27.50 *circa*), fixed with mud-bricks, which have been found almost completely crumbled.

Scattered fragments of animal bones, rarely shards of pottery have been discovered together with tiny bronze pieces (much corroded) and they have not been collected. Some of the discovered materials were modern, i.e. pieces of aluminium and modern glass.

The removal of the structure revealed the way the basin has been raised up in antiquity.

It stands on dressed limestone blocks, covered by polished slabs probably coming from the most ancient paved floor of second phase (i.e. US337floor, see below).

According to the setting of the stones, the structure seems to have been reinforced in different times. A huge basin with a protruding gutter rectangular in section, has been re-employed to sustain the new basin (measures:  $0.67 \times 0.27$ ; measures of the gutter:  $0.24 \times 0.28$ ).

The works performed to raise up the basin left traces in US335 recognized, southern from the basin, below US329 and at the same elevation of US293 below US264floor.

US335 (average thickness 35 cm) was made from mud-bricks (most of them crumbled) and un-shaped blocks of limestone and sandstone, medium-small in size. Some pieces of plaster have been found scattered on the layer. The colour was graysh, due to the crumbled mud-bricks which also made the layer so compact and hard. US335 covers finally US339 (upper elevation: 27.08; lower elevation 26.95) which insists directly on the filling US46.

Another operation performed during this campaign was the enlargement of the trench dug in SUM09A with the purpose to reach M18 and its foundation. The goal was not obtained because of the finding of M317, which is bigger than we thought. M317 is in fact a real wall and not just a "pillar", as seems to emerge in SUM09A, with the dimensions of 1.42x0.97.

Southward we decided to remove M316, clearly a later addition made from two rows of stones standing on the huge filling US46 with the goal of understanding the real dimensions of M317 and, above all, the relation between M265 and M317.

Here we expected to find traces of the passage connecting an hypothetical stair below the "corridor" and the ancient shaft of the well. Was quite surprising the discovering a new wall, M342 (see sketch n. 2)

The relation with M317 is not perfectly clear because of the presence of a quite thick layer of mortar placed in the corner between the two compartments. For what is concerning M342, the wall seems to be tied in the lower part with M265 while it seems just leaning to it in the upper part.

The presence of wall M342 did not aloud us to reach M17 and so to check the existence of a staircase, but the excavations confirmed the presence of two floors: US332 floor (elevation: 25.36) and US333floor (elevation: 24.90)

The last one stands on the circular structure already recognized in SUM09A and named M303 (elevation: 24.83) and it consists in a quite thick layer of hard compact earth, graysh in colour. The level is approximately at the same height of the lower frame of the well and probably floor and frame were connected by means of fine worked limestone slabs, found this year in proximity of the well.

The material placed upon US333 floor (i.e. US333) consists in big roughly worked limestone blocks which have been used as foundation for a different trampling level, US332floor, made from compact earth and small stones, and used as basement for the walls M342 and M265 (elevation of US332floor: 25.36)

US332floor was covered by its related accumulation (it means the natural accumulation due to the usage of the floor), namely US332, made from quite rather compact earth, small stones and some bones.

On this layer (US332) and not on the limestone blocks (US333), we recognized the huge filling represented by US46.

The possibility that US332floor could represent the base of a kind of step connecting the lower US333floor with an hypothetical ramp of first phase has been taken into account but it needs to be demonstrated.

Contemporary we started to dig a trench near wall M18 with the goal of reaching the foundation of M18 (dimensions of the trench: 1.8x2.4 m circa, see sketches 3, 4). It has not been possible to satisfy our purpose because of the finding of some slabs which are interpretable as what remains of the first floor of the MB in its second phase (US337floor) as confirmed also by the elevation (26.84) which is at the lowest level among the floors brought to light in the court of MB (fig. 3).

The section of the trench shows almost all the layers brought to light in the corridor: US264floor (elevation: 27.56), US293 and related floor (elevation: 27.40), US294 and related floor (elevation: 27.20). By the way the last layer discovered in the corridor, US262 with its related floor, has not been found here. It means that in this area different kinds of interventions, probably connected with the raising up of the flooding channel, have been performed.

Below US294 floor we reached a quite thick level made of chips of sandstone and limestone with some charcoals (sampled for possibly C14 analysis), pottery and bones. It's US 334. A big toe of amphora (US334,1) has been found in the layer. The layer (considering its composition) is supposed to have been used to fill and level the surface for the building of another floor.

US334 (thickness 30 cm *circa*, sup. elevation 27.25, inf. elevation 26.90), covered US340, a more compact layer which originally sustained the slabs of floor US337.

US340 (sup. elevation 26.90, inf. elevation 26.68) is more than 20 cm circa in thickness and it's made by rather compact brownish earth with some chips. On US340 insists US337floor.

US337 floor (elevation: 26.84) actually consists in a series of 4 slabs (but a fifth is recognizable under wall M346 and some others are supposed to stay in the un-excavated area southward, towards M17, below the benches and the floors) with the dimensions of 0.66x0.58; 0.43x0.62; 0.47x0.80 and 0.46x0.51. The average thickness is 9.5 cm. Traces of plaster, probably used as binding material, are visible on the short sides.

The north side of the section, towards the channel, is delimited by a row of six roughly hewn blocks, namely –also if improperly - M346, and insisting on US337floor and on US340.

The idea is that M346 as well M347, perpendicular to it and also made from just a row of 4 sandstone blocks, have been used to raise up the foundation of a second floor, US341floor, made, this too, of flat and polished limestone slabs (elevation: 27.24).

For some reason it seems that it has been necessary to raise up the trampling level: some of the slabs of US337floor have been re-used for US341 itself; some others could have been employed in different places (see, for example, the polished slab used at the base of the huge basin).

At the moment of the discovery US341floor was made of six polished slabs of variable size and it was delimited from a long stone, almost square in section (measures: 1.05x0.11x0.13) and broken in three pieces, in the southern part; from the raised border of the channel in the northern one.

US341floor was covered by US293, found below US264floor.

The area between this floor and the upper shaft of the well was object of many changes and rebuilding as attested by the stratigraphy that, here, is not homogeneous with the one individuated in the other parts of the building. Below US264floor just another floor has been found, US293, at an elevation of 27.27. It insists directly on a filling of chips standing on US46 reached here at an elevation of 27.06.

The last operation performed in SUM09B was the digging of a deep sounding in the corridor (fig. 4) with the goal of checking the existence of steps of an hypothetical staircase connecting the entrance with the shaft of the well in its first phase.

A square of 60x60 cm has been excavated in the corner between M17 and the last step going down to the corridor, starting from an elevation of 27.02 (= US262floor).

As already noticed with the deep sounding in room A108 also inside the MB, wall M17 does not insist directly on the bedrock but covers a thick and very hard layer of chips and earth, i.e. the foundation filing which has always been individuated upon the bedrock.

The foundation of the wall is at an elevation of 26.57; the bedrock has been reached at an elevation of 26.24.

The difference of elevation of the bedrock discovered in relation with the internal and the external face of M17 (respectively 26.24 and 27.43) let us to argue the existence of a natural depression.

However we think that the rock has been cut according to a funnel shape (see also the circular structure discovered inside, namely M303) to reach easily the shaft of the well and going down to the water.

No traces of steps have been discovered below US262floor.

The lack of them let us to suppose that, during the first phase, the shaft of the well was reachable by means of a ramp of an inclined plan which we suppose could follow the natural inclination of the bedrock. Otherwise wooden ladders or pulleys could have been employed.

### General considerations

As already emerged during the last excavations of SUM09A two big phases of occupation with multiple sub-phases not clearly ascribable in a chronological range, have been individuated.

## First phase

This phase is datable to the so-called KRI period, from the foundation of the settlement until the I cent. AD.

The well was exactly at the centre of the construction delimited by walls M16, M17, M18, M19. It has been impossible, until now, to reach the foundation of these huge masonry works with the exception of M17 (bedrock reached at elevation of 26.24 inside the MB; at an elevation of 27.43 outside the MB).

The walls M22 and so M314, M303, M266 do not aloud to check the original foundation of M16, as well as the series of floors in the corridor between M265, M316, M317 (constituting in the last phase an unique structure) block the possibility to dig deeper.

If in the last seasons a first utilization of the well was suggested just according the layout of the structure, this year we have been able to find the two floors related to this phase, i.e. US333floor (elevation 24.90) and US332floor (elevation 25.36).

## Second phase

The second phase, datable in a period of huge re-building works in the city, was connected with a general raising up of the structure.

The small walls found inside the structure, standing on the lower levels, on the bedrock or of the limestone blocks used as foundation, have been used for this purpose.

At the moment the most realistic hypothesis is that some of them could have a static function connected with the descent to the shaft (M265 for example) while the others could have been built to divide the space surrounding the structure of the well M300, creating compartments to be filled with the stones constituting US46 (see also Sedov, personal communication).

By the way if these structures served just to divide the space the very good plaster which covers some of them and which seems waterproof is impossible to explain.

The well

One of the main problems of the MB is represented by the well itself or, better, if the structure has been constructed in one or two different moments.

Observing the structure from the inside, it seems absolutely the result of a unitary project.

By the way, from outside it's clearly visible a lower frame interpretable as the former shaft of the well.

No one of the hypothesis made about the structure is completely convincing.

However we could suggest that in a first phase they use a very simple type of well, i.e. a structure roughly dug in the rock which constitutes the platform where the city has been built.

In a second phase (KR II – at the same time of the great changes occurred in the city: monumental gate, temple, area A), it has been raised up and, contemporary, lined with a very well done masonry along all its height.

Another observation attains the big basin connecting the well with the channel. Here, the height of the water, seems to have been steady. A natural mark in the stone indicating the level of the water collected inside the basin is, in fact, clearly visible.

This feature let us to argue that the basin was used more probably for the decantation or conservation of the water than a device for the flooding of it.

The passages

As already cleared during the past campaigns the MB seems to have had just one entrance, placed in M16 (see Sedov in SUM09A).

From here some steps (later covered) led to the floor US262.

An other passage has been found (walled-up already in antiquity) on M18, and it was connected the channel.

This second "door" with an architrave on the top, seems to be linked with maintenance works, it means to keep clean and control the passage.

Here, a thick deposit of sediments (70 cm *circa*), shows that the walling-up of the passage has been made when the channel was not more in use.

However the height of this opening seems too big to be used just for maintenance works; is it possible it could be connected with the exploitation of the water in the first phase?

# Area F: a new trench extending in western direction (trench supervisor A. Lombardi)

During the SUM09B campaign in Sumhuram (04.07 - 25.07.2009) the excavations at the Area F were carried out in the squares h-g/6-7.

At the beginning we opened an irregular rectangular trench (9.00x4.60 m in size), oriented North-South and placed exactly along the trench of the SUM09A mission, in western direction. Between the two trenches a bulk of 1.50 m has been leaved, to allow the transit of wheelbarrows.

The limits of the trench were the following: the modern raised platform of the tourists path to the south; the wall – partially excavated – of the building BF6 (M155), to the north; the bulk itself to the east and, at least at a first moment, an accumulation of surfacing stones, placed obliquely, to the west (fig. 5).

The main goal of the operation was to complete the excavation of the building BF7, to continue that of the street A129 and, in general, to enlarge as much possible the excavated area towards the Temple of Sin, in order to clarify the urban arrangement of the religious quarter.

## A new hypothetical building

Under the southern modern platform an ancient wall (M340), oriented east-west, was visible from the beginning. This wall, excavated only in its northern face, goes down until the level reached in the trench (placed at an elevation of 28.08 m). It was clearly related with another perpendicular wall (M339), whose top was emerging from the surface. The masonry of the two walls is tied and, in addition, both the walls are covered (at the same high level) with an unique stratum of whitish plaster (fig. 6).

For the above mentioned reasons it was impossible to carry out a complete excavation in this part and so, at the present, it is difficult to know the exact function of the two walls inside the urban organisation of the Area F. Probably, they belonged to a new building which developed in south-western direction (the top of another wall – M349 – running parallel to M340, has been singled out in western direction). So, we can imagine that this hypothetical new building, more or less aligned with the Building BF5, was overlooking on the square A20, the large open space in front of the *intra-muros* temple, BF3.

### Stratigraphical sequence

The top stratum (US330), covering the entire trench, was a very soft sandy aeolian deposition, mixed with stones of various sizes, a large amount of stone flakes and a few pottery shards. The US330 produced also a fragment of a limestone circular-shaped incense burner of roughly manufacture (S1379).

A second more compact occupation layer (US331), traced only in the southern part of the trench, consisted in crumbly earth, with a large amount of whitish inclusions, mixed with ruins of greenish mud bricks, charcoals, pottery shards, animal bones, sea shells and some fragments of soft-stone vessels (S1381, S1382, S1383). The US331 ended in a rather hard and irregular floor, unearthed in correspondence with the bottom of the well preserved stratum of whitish plaster spread on the wall M340 (at 29.03 m in elevation).

After the removal of the two layers US330 and US331 we have found the same stratigraphical sequence traced during the previous campaign inside the streets A80 and A129. This sequence includes, from the top to the bottom, the following occupation layers: US306 (=US80), US309 (=US187) and US313 (=US196), all characterized by greasy and compact earth with a large amount of charcoals, ashes (found especially in US306), a huge amount of animal bones, most of which of big dimensions, sea shells and pottery shards. In particular, the US309 produced six fragments of soft-stone vessels (S1384, S1386, S1387, S1388, S1389, S1390); two *chlamys townsendi* shells used as oil lamps (Sh342, Sh344) and one fragment of grinding slab (S1385). The thick occupation layer US313 produced two bronze coins (Co550 and Co552); two whetstones (S1391, S1392); a decorated shell button (Sh343); an iron rod (MI146); a fragment of bronze hairpin (MB561) and a cube-shaped small bronze object (MB564).

## **Building BF7**

The excavation revealed the exact dimensions of the building BF7 (10.37x5.60 m) and the profile of its western room A132 (3.35x4.10 m in size). The presence of the bulk doesn't allow to excavate inside this room, which appears divided in two half sized units (A132 and A132a) by the late partition wall M348 (0.60 m in width). Inside these two small rooms (too small for the excavation works) we stopped at the late level of occupation (US321floor), related with the phase of the US306.

Rather close to the eastern limit of the trench the perimeter wall M343, which closed the building BF7 to the western side, has been unearthed and excavated for a height of 1.10 m, i.e. for 5/6 rows of stone blocks. The type of masonry is the same of the others walls of BF7, M306 and M307: medium size limestone blocks, roughly worked and not perfectly aligned, tied with a very coarse clay mortar. Its northern corner, tied with the perpendicular wall M307 is well preserved, while its southern corner probably was collapsed and restored in ancient times. In fact, at a lower elevation (28.32 m) of about 0.75 m compared with the top of the wall (and clearly in relation with the layer US313), the original south-western corner of the wall has been unearthed. This small portion of wall, which constitutes also the southern perimeter wall (M344) of the building, appears completely ruined and filled with a clay reddish mortar. It is very probably that this corner was restored in ancient times: the wall in its upper sector was shortened and, in order to strengthen the unstable structure, it was tied to the adjacent wall M339, which appears to be part of a probable more recent building (fig. 7).

But this part will be completely clarified only after a further investigation of the building BF7 towards south, directed to bring to light the entire southern perimeter wall M344.

## Street A129 and "square" A135

The oblique accumulation of stones, which constituted the western limit of the trench, is actually a very late dry-stone wall (M341), preserved for three rows of medium size stones and filled with small stones and flakes. As regards the orientation, this oblique wall is not homogeneous in comparison with the others structures of the area and clearly belongs to the late occupation phase related with the US306 (=US80), during which the wall M341 appears to close towards west the space in front of the building BF7.

After its demolition it appeared clear that the area excavated in front of BF7 was originally an open space (A135), crossing at the north with the street A129. At the present it is difficult to know if this open space A135 was part of the square A20,

constituting its eastern limit, even if this hypothesis is not to be excluded. The area A135 has been excavated until an elevation of 28.08 m, inside the filling US313. For the short time available the floor is not been reached (fig. 8).

The demolition of the wall M341 allowed also the continuation in western direction of the excavation of the street A129, where we was able to reach the floor US313, as in the other eastern sector excavated during the previous mission, behind the bulk.

In addition, the possibility to join with the previous excavations in western direction of the Area F has showed that the street A129, starting from the eastern wall of the Monumental Building, was running directly towards the *intra-muros* temple (fig. 9).

### **Building BF6**

The demolition of the late wall M341 has been useful also for cleaning the southern face of the wall M155, the perimeter wall to the south of the building BF6.

In order to carry out the works in the western part of this building (already investigated by the AFSM expedition), during this short campaign we was able only to excavate a little bit inside the rooms A72 and A72a (US336), to clean the partition wall M345 and the bad preserved wall M160. The presence of the bulk for wheelbarrows, which divides in two sectors the building BF6, doesn't allow to understand if the rooms A71, A72 and A72a was an integral part of the building BF6 or, more probable, constituted a separate new building which was attached later to BF6. In fact we can see, running parallel to M160, a second alignment of stones (which could be the original western perimeter wall of the room A127) and, between the two walls a very hard filling, composed of light brown mud bricks (fig. 10). This filling probably joined the two originally separate buildings, but we have to verify it in the next mission (sketch 5).

### Future research

Others investigations in this part of the city will need to verify all our hypothesis.

In addition, it is very important to complete the excavation of the buildings BF7, BF6 and the probable new building to the west.

It will be interesting also to bring completely to light the area between the Monumental Building and the *intra-muros* temple BF3. In this way an entire quarter of the city – the religious quarter – will be visible and fully appreciable from the visitors of the archaeological site of Sumhuram.

#### Area E (Trench supervisor: Said al-Mashani)

In order to expose the eastern side of the city wall we started, in this campaign, an important operation of cleansing to remove the dumps accumulated by previous excavations and wind deposition.

The works have been carried on with JCB and, near the compartments of the city wall, manually.

The corner between structures A103 and A104 has been cleaned and the large amount of dumps between the modern staircase and the city wall has been reduced.

For static reasons linked with the stability of the staircase has not been possible to remove completely the accumulation.

The same work of cleaning made by JCB and manually has been performed between the modern staircase and the eastern isolated tower. A large amount of stones collapsed from the city wall and accumulated from previous excavations has been removed.



Fig. 1:Area A - the Monumental Building (MB) before the excavations



Fig. 2: Area A - Monumental Building (MB) after the excavations



Fig. 3: Area A - Monumental Building (MB), the paved floors



Fig. 4: Area A - Monumental Building (MB), deep sounding in the corridor near M17



Fig. 5 - Area F: the sector before the excavation works (from the south).



Fig. 6 – Area F: the excavated trench with the modern platform and the wall M340 (from the north).



Fig. 7 – Area F: particular of the walls M343, M344 and M339.



Fig. 8 – Area F: the open space A135 from the south.



On the right the wall M343 of the building BF7.

Fig. 9 – Area F: the street A 129, from the east. On the right the wall M155 of the building BF6.



Fig. 10 -Area F: the west sector of the building BF6, from the north-east.



Fig. 11: Area E before the cleansing operations



#### **TECHNICAL REPORT n.2/2009**

**Obj:** Structural activities on the archaeological site of Khor Rori, Salalah (OMAN).

#### PREFACE

In relation to the short archaeological campaign hold by the Italian Mission to Oman in the site of Khor Rori (4-23/07), directed by Prof. Alessandra Avanzini of the Dipartimento di Scienze Storiche del Mondo Antico, University of Pisa, structural restoration interventions have been programmed on collapsing masonry walls, with the aim to achieve a satisfactory level of safety, to permit further studies and to consolidate the walls collapsed.

The programmed restoration interventions consisted in:

• restoration of wall M281;

with the aim to complete the consolidation of all the north-eastern side of the city wall. Restorations have been done following the same proceedings of the past campaigns, according to the UNESCO issues.

#### **1. GENERAL DESCRIPTION OF THE INTERVENTION**

#### 1.1. DISMANTLING AND RECONSTRUCTION OF WALL M281

M281 is one of the compartments of the city wall and it has a North-West/South-East orientation. The length is 9.40 m., the height varies along its borders, reaching a maximum of 3.30 m. above the excavated level.

To reach the first of row of well preserved masonry blocks we dug a trench of 0.50 m in front of the wall.

The programmed intervention involves static, historical and aesthetical aspects, since it is aimed to put the wall in safety conditions, besides to endow it with a pleasant appearance, consistent with the other masonry structures in the site. To attain this purpose, a first phase is prescribed, in which the damaged parts of the wall must be dismantled, while the integer ones will remain unmodified. As this operation has been fulfilled, the wall has been rebuilt. The reached level constitutes an authentic estimation of the minimal height the wall featured in the past, using the collapsed stones in front of it, and thereby represents an attainable level in terms of archaeological correctness. Prior to the wall rebuilding, a narrow geo-textile strip will be applied on the upper face

of the old stones on the external surface, to remark the separation between the unmodified ancient masonry and the new part introduced with the present restoration.

For this reason the intervention program was characterized by the following aspects:

- rebuilding the masonry structure according the hypothetical original order;
- preserving the original aspect of the wall, according the UNESCO issues;
- denoting the rebuilding phases by way of a geo-textile layer between the unimpaired wall and the reassembled part.

To realize the upper closure of the wall, some stones have been put in an irregular arrangement and linked together with mortar (so called "beautification"), with both the aesthetical purpose of making the wall looking similar to the others in the site and the technical purpose of making the wall waterproof.

#### 2. WORKS ACCOUNT

#### 2.1. RESTORATION OF WALL M281

#### **2.1.1. Dismantling phase**

The restoration works on wall M281 began on July the 6<sup>th</sup> with the dismantling operations of the damaged parts of the wall itself with a few number of workmen. The stones and the earth forming the wall body were heaped nearby, in the outlook of a following usage during the wall reconstruction. No stone was removed from those parts of the wall featuring structural integrity and a proper masonry arrangement.

#### 2.1.2. Used materials

As in the past campaigns, walls have been rebuilt using local stones and a particular mortar mixture.

• Mortar mixture. The mortar mixture has been determined by making some tests with different proportions of colour and lime in order to obtain the right colour. The chosen mixture has been essentially determined by observing the outcomes of the mixtures previously employed in the site of Khor Rori. On the base of such assessments, it has been decided to give up the cement component and neither to employ natural earth withdrew from the ground, according to the UNESCO issues. This because many mixtures containing those elements showed in the past sensible colour variations, reasonably as a consequence of

chemical reactions which led to formation of mineral salts. In this aim, artificial brownish sand, produced crushing local stones, was selected; and the 1:4 mix proportion was regarded as the most suitable in this case. After these tests, the natural colours proportion has been set to: 1 part of yellow, 1/4 of brown, 20 parts of lime. The mixture, this year, employed less brown because of the colour of the sand, more red. So the standard mixture was made with four buckets of sand and one bucket of the previous mix of lime and colours.

- *Stones arrangement.* The masonry units were withdrawn partially from the ones resulting from the dismantling phase, and partially by the other heaps present in the site.
- *Surface refinement*. After rebuilding the wall for a certain length, the external surface was adjusted filling carefully the leaks between the stones with mortar, and then, as soon as the mortar had became enough consistent, smoothing the joints with soft brushes. Finally, the stones external faces have been cleaned with sponges and clear water.

#### 2.1.3. Wall reconstruction

On July the 11<sup>th</sup>, after completing the trial session, the rebuilding operations on wall M281 were started. They concerned the following issues:

- *external sides*. Beginning from the structures remained essentially undamaged over the centuries, they have been rebuilt according to the same procedure, elaborated through the walls restoration in the previous campaigns. A film of geo-textile has been posed in the first mortar joint to separate the new rebuilt part of the wall from the old one. At the end 10 completed lines of stones have been rebuilt in the external side with some "steps" made on the top in order to harmonize the wall with the others near by.
- *internal region*. The wall body was rebuilt using stones and layer of mortar. The lime percentage was fixed to 1:20.
- *upper closure*. It was realized arranging stone irregularly, to reproduce the appearance shown by the tops of the other walls. The gaps between stones were filled with the same kind of mortar used for the external sides, and afterwards they were likewise refined, using the described technique.



Wall M281 before the restoration from North



Wall M281after the restoration from North