DESCRIPTION OF THE WORKS

4.4 Repairs on exterior masonry (cut and fill and pointing)

This intervention aims at repairing damaged masonries, notably those on the very top of the boundary east wall of the castle, on the west elevation (blocks deeply pulverised) and on the south elevation (cracked rubble masonry).

Particularly delicate is the intervention on the top wall. Here a crack has occurred along the joint between two construction phases. The crack was caused by possible subsidence of the exterior wall, which has not affected with the same entity the interior wall. The crack has left a wide open joint (max 10 cm) exposed to the elements, thus allowing rain water to penetrate into the wall and infiltrate into the masonry. The intervention aims at removing ancient repairs, repairing crack masonries and sealing vertical joints.

4.4.1. Removal of all cement-mortar repairs and replacement with new mortars (bedding-mortar + pointing).

4.4.2. Bedding mortar. Cracks exceeding 2 cm must be filled with small rubble and bedding mortar to create a support to mortar, as follows:

Remove dust and debris.

Dampen joints to control suction as necessary.

Apply the mortar with a spatula in the deep voids that need to be filled, adding some fragments of wet brick if needed. Bedding mortar surface has to be recessed from the final surface of the stone.

Press the mortar with proper tools.

Once the carbonation process has started, the surface has to be impressed by several crossed lines in order to make easier the adhesion of the following layer of mortar.

4.4.3. Pointing mortar to seal of joints between stones. Pointing mortar has to be prepared on a selection of lime mixed to on site available materials (stone dust, brick dust) sieved at different gradients in order to match in texture and colour to original mortar.

Remove dust and debris.

Dampen joints to control suction as necessary.

Press mortar with a spatula well into joints so that they are fully filled.

Ensure that no mortar encroaches upon the face of the masonry.

Finish joints neatly to match existing adjacent joints.

Press mortar with a sponge to let the stone grains come out.

Wash the surface with atomized water in order to remove the superficial layer of lime.

After the starting of the carbonation process press and damp with atomized water must be repeated to slow down the carbonation and to improve the mechanical resistance of the mortar.

4.4.4. Cut and fill. Repair of stone-masonry deeply damaged, with cracks or wide open joints with cut and fill technique. Damaged blocks have to be removed carefully and replaced with new ones, having the same

dimension as the ones that have been removed. Stones must match in colour and texture to the existing one. New blocks to be kept aligned to original one even if not vertical or horizontal.

The intervention is not meant to strengthen the masonry but only at repairing blocks that are exposed to the elements.

Joints between two masonries belonging to different construction phases must be kept separated and the joint filled with small rubble as described in 4.4.2. and 4.4.3.

Masonry belonging to the same phase: reconstruction to make as good as new.

4.4.5. Extra protection of the horizontal joint between two masonries, when exposed to the elements, through a metal sheet (possibly lead) to ensure water not to leak into the joint.

4.4.6. Repointing to opened or damaged joints. To be carried out as follows:

Remove mortar carefully and without damaging adjacent masonry or widening joints. Form a neat square recess of depth not less than twice thickness of joint. Remove dust and debris.

Dampen joints to control suction as necessary. Press mortar well into joints so that they are fully filled. Ensure that no mortar encroaches upon the face of the masonry.

Finish joints neatly to match existing adjacent joints.

Press mortar with a sponge to let the stone grains come out.

Wash the surface with atomized water in order to remove the superficial layer of lime.

After the starting of the carbonation process press and damp with atomized water must be repeated to slow down the carbonation and to improve the mechanical resistance of the mortar.

4.4.7. Repairs of the south elevation. This intervention aims to repairing the cracks and open joints of the south façade. Following interventions are envisaged:

Sealing of all open joints;

masonry intervention to reactivate the water spout of the east end of the wall, which will include: demolition of the masonry; new masonry to create a drain on the roof terrace, including membrane and lead protection; down tube connected to the water spout;

cut and fill along the crack on remains of the cross-vault to the south of the hall.

4.4.8. Repairs on the west elevation. This intervention aims at repairing decayed stones and open joints of the west façade. Following interventions are envisaged:

seal of all open joints;

cut and fill on sandstone blocks deeply eroded.

Colour veil aesthetical treatment on new stones to reduce tonality of new stones in order to guarantee an homogenous colour between new and old stones. Application of the 2 or 3 coats of colour veil to be done with a soft brush and taking into consideration the different absorption of the stones. Composition must be decided upon samples to be approved by the Engineer. Typically the composition shall use the following materials: water, primal AC33, lime and natural colours (such as Siena Yellow, Burnt Umber, etc.).

4.5. Intervention on drains

Existing drainage is insufficient to drain water in case of heavy rain. For this reason it is necessary to repair/implement existing water system. Interventions are envisaged only on the drains merging on the downpipe of the hall.

4.5.1. Protection. During the intervention on the down pipe it is necessary to protect area against rain water. To do so the contractor will realise a temporary barrier around the drains, in order to divert water to existing drains. For this reason the intervention must be carried out after intervention on perimeter membrane (see 4.9) and the drain on the south facade is reactivated. In case of rain area will be protected with polyethylene sheet.

4.5.2. Demolitions. Demolition of downpipe and of manhole, including concrete masonry in the sector where the downpipe passes into the vault and drain from the manhole to the courtyard. Demolition of the drains to downpipe on the terrace. Demolition of the separation wall between the two roof terraces, as described in the drains. Clear the site of rubbish, grub up bushes, shrubs, vegetation, etc., clear and cart away.

4.5.3. New pvc downpipe and lower manhole ø16 cm, with watertight manhole cover. Connection of manhole to exterior drain system. On the terrace the downpipe will be properly connected to a drain channel protected by a removable (for inspection) dome grating. Joint between the downpipe and the terrace made with double sealing, with damp-proof fibre-reinforced membrane.

4.5.4. Open-air channel from north terrace to south terrace: damp-proof membrane, bedding mortar and tiles to the drain corresponding to the downpipe, as described in the drawings.

4.5.5. Copper cover around pvc pipe, fixed to the wall with screws placed on the mortar joints.

4.6 Repairs of the closings on the west and south façade

This intervention aims at repairing the wood closings on the façade, which were built against glazed wooden frames. The glazed surfaces were originally designed to let light into the hall.

In terms of preservation of the hull, the insulating efficiency of closings affects the climate condition in the hall. High temperature in the exterior and air permeability jeopardize proper conservation of the hull and rise the need of a incisive intervention. Poor insulating capability of the closings as well as aging of wood are two major problems that need to be addressed through a demanding intervention.

The whole dismantling of existing wood sheathing, substitution and enhance insulating properties is the aim of the intervention. The contractor must pay attention to the proper sealing of all the joints between the closings and the walls, as well as the accurate sealing of the custom doors, by means of perimeter gaskets.

4.6.1. Dismantling of existing closings, including wooden boards, glasses, insulating panels, and interior panels. The timber frame must be preserved, transformed and fixed, to be as good as new.

Decayed timber elements must be cut off and supplemented with new ones in order to transfer properly loads into the shear walls. New timber must be scarfed to existing, wedged and bolted top to bottom.

Propping of frames must come first any cut is done to existing timber frames.

Metal frames supporting new doors must be connected to timber frames by metal brackets and flanges.

4.6.2. New timber closings have been designed to create a tight closing and reduce permeability. For this reason two main elements must be guaranteed: seal of all joints along the perimeter and around the openings; create a ventilated cavity to reduce effects of irradiation on the surface. In the interior the aesthetical presentation of the surface will be white painted. To be realised as follows:

Cut timber frame and adapt to new openings.

Insert metal frame of new doors.

Screw exterior 20mm thick OSB panel to timber frame. Boards need to be placed as close as possible to the border stone wall, to seal any possible joint, taking care not to damage the stone. Joints between boards to be covered by sealing tape for OSB panels.

Black water-based acrylic paint on surface, taking care to protect all contact areas with stone work against paint damage.

Extra seal to joints OSB/stone and OSB/metal frames with a L shape flexible galvanised metal element and a self-expanding gasket. Metal seal and gasket need to be positioned simultaneously. Metal element to be nailed to OSB panel. Self-expanding gasket will give a perfect seal to the borders of the OSB surface, though using a "dry" technique.

Protection of the footing of the OSB surface with a galvanised sheet L shaped element.

Flexible wood fibre insulation in between the timber frame th. 110cm density 50Kg/m3, placed from the inside against the OSB panels.

Interior panelling of the closing with gypsum fibre board 25 mm screwed on the timber frame. Panels will be placed horizontally.

Plasterboard and skim on gypsum fibre panels.

Jamb stud to support exterior timber cladding 80x40 mm (to leave a cavity 80 mm thick) along the edges of the sheathed surface.

Larch timber cladding 25mm. Boards with scarf cut on both ends in order to increase resistance to rain. Boards will be secret-nailed with stainless steel nails.

Finishing/protection of larch: the larch is intended to get the colour of graphite through aging. Protection against fungal and insect attack made by a non-layer-forming wood finishing treatment based on natural raw materials, to be applied on all the surfaces of the wood. Exterior surface to have a weathered appearance, to be accomplished or with specific natural surface wood treatment or through impregnation fluid added with grey colour pigment.

White paint to fibre-gypsum panels.

4.6.3. New closing between the hall and the toilet building. Existing closing to be dismantled and

Exterior panelling of the closing with gypsum fibre board 25 mm screwed on the timber frame. Panels will be placed horizontally.

Flexible wood fibre insulation in between the timber frame th. 110cm density 50Kg/m3, placed from the inside.

Interior panelling of the closing with gypsum fibre board 25 mm screwed on the timber frame. Panels will be placed horizontally.

Plasterboard and skim on gypsum fibre panels.

4.7 Stairs and ramps

4.7.1. New exterior staircase to west entrance.

Existing stairs to present door will be demolished.

New masonry staircase as wide as the new entrance (1.30 m) similar to the existing one. New staircase centred to entrance.

Building material for staircase with local limestone ashlars (Reusable materials coming from demolished stairs will be employed).

4.7.2. Access to emergency door at the level of the balcony. To connect the level of the balcony to the one of the emergency exit on the east opening on east wall, which is 30 cm higher, a step must be created into the existing masonry through cut and fill technique.

4.8 New doors

4.8.1. Emergency exit from the balcony to the roof of the toilet building.

An emergency exit is provided from the balcony to the terrace above the toilet building. This exit, to be used only as an exceptional escape route, may also be used for the maintenance of the terrace. New emergency exit to be realised in the east opening of the south façade, as follows:

Metal frame anchored to the stone-wall, with threaded rods fixed with epoxy, inserted possibly into the joints between stones.

Seal of joints between stones and metal frame with a L shape flexible galvanised metal element and a self-expanding gasket, as described in 2.6.2. Cover metal frame with larch board, placed at the same level as the timber finishing of the leaf of the door.

The door leaves open outwards: metal frame hinged (four hinges to support the weight of the leaves) to supporting frame; interior panel made with fibre gypsum board; exterior boards with horizontal scarfed boards; flexible wood fibre insulation in between the timber frame th. 110 cm density 50 Kg/m3; gasket on supporting metal frame; gasket on leave metal frame. Emergency four-point deadbolt system with an emergency exit paddle on the interior which instantly retracts all moving deadbolts with one depression of the paddle.

Wood protection against fungal and insect attack made by a non-layer-forming wood finishing treatment based on natural raw materials, to be applied on all the surfaces of the wood. Exterior surface to have a weathered appearance, to be accomplished or with specific natural surface wood treatment or through impregnation fluid added with grey colour pigment.

white paint to fibre gypsum board.

4.8.2. Automatic sliding door at the level of the balcony.

Automatic sliding door is proposed to reduce permeability in the passageway between the sector where the artifact exposed and the adjoining room. Automatic sliding door systems and options shall be factory certified to meet performance design criteria. Door to be placed as shown in drawings. Door is composed by a soft-wood jamb and metal upper supporting rail, the latter having a soft-wood covering.

Particular attention must be given to weather-stripping to be placed on door jambs, on higher rail and on the bottom of the sliding door.

Opening will be operated manually through a switch, placed on door jamb and in passageway to the hall exposing the artifact.

4.9 Damp-proof membrane and aesthetical treatment

4.9.1. Toilet roof.

Remove gravel from the terrace. Verify condition of membrane, if cracked for aging, replace. Verify existing membrane along the joint with the stone wall on the north and east side and supplement/add if necessary. Place back gravel.

4.9.2 Exhibition hall roof.

Add membrane along the perimeter wall, reversed for min 10 cm height.

Aesthetical treatment of membrane along the whole roof surface of the south terrace (terrace above the exhibition halls) with pigmented epoxy coating.

6. FIGURES

6.1 Views

Fig. 1 External view of the hall (West elevation)

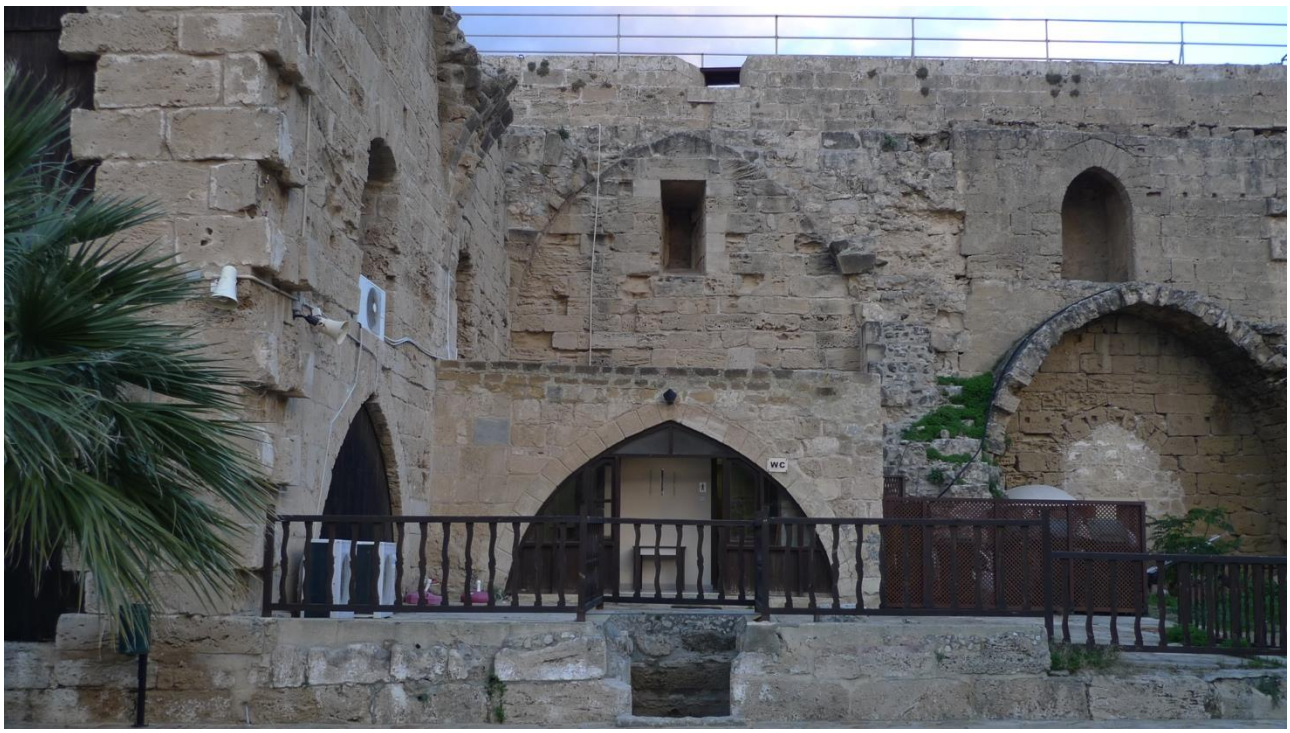

Fig. 2 View of the structures on the South side of the hall with the modern building housing the toilets. Above is visible the original (collapsed) barrel vault.

Fig. 3 View from south towards the hall, showing the outer South elevation of the hall with the four external units of the A/C system

Fig. 11 Exterior view of the extrados of the vault showing recent waterproof membrane shelter.

Fig. 12 Detail of the terrace. On the left – remains of a barrel vault with minor crack. On the right – a wall supporting once an external A/C unit (?)

Fig. 13 View of the roof of the toilet and the area destinated to wastes.

Fig. 14 One of the pointed arches at the lower floor with the MDF panel and the internal A/C unit)

Fig. 15 View of the top of the exterior wall of the castle. The crack runs along the limit between the 1st and the 2nd phase of the construction.

Fig. 16 Detail of the drain of the larger terrace. The membrane doesn't cover the joint between the roof and the walls.

Fig. 17 Detail of the area where the drain of the terrace above the hall is located (hidden by vegetation). The slab is placed on the downpipe.

Fig. 18 View towards the Western edge of the roof. On the right – the extrados of the barrel vault covering the hall.

Fig. 22 Salts on the stone surface – detail

Fig. 26 Damage of the timber cladding and detail of the pipes connecting to interior A/C units

Fig. 27 The entrance door doesn't close hermetically. Damage due to humidity is visible on the interior MDF

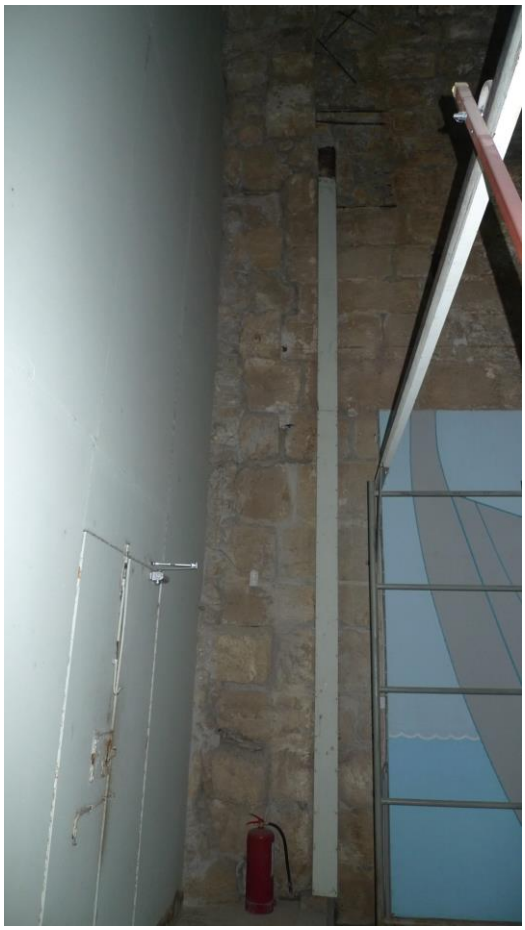

Fig. 28 Downpipe (hidden by an external wooden carter coming from the drains on the roof. There is a concrete patch where tha vault was demolished to insert the downpipe.

Fig. 29 Bottom side of the timber cladding on the West facade damaged by humidity. The supporting beam is also damaged.

Fig. 30 View of the West closing of the West facade from below.

Fig. 31 Crack in a small room under the upper exterior passage way.

Fig. 35 Cement patches on the crack along the passage way on the top of the external wall of the castle.

Fig. 36 Water spout originally used for the terrace above the hall. At present unused.