Georgian Arts and Culture Center
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PROJECT FOR CONSERVATION INTERVENTION OFTHE DOME DRUM OF THE MAIN CHURCH IN GELATI, GEORGIA.

1. STATE OF CONSERVATION

Stones of the dome drum present a great variety of forms of decay.

A profuse green/brownish-blackish layer of biological growth, clinging into the stone alveoli and spreading also inside cracks and fissures, can be observed over the surfaces (mostly foliose and crustose lichens and algae; sometimes weeds like *Parietaria*): microflora causes not only aesthetic decay but also physical/chemical deterioration of stone substratum, connected to growth and metabolism of vegetation (development of roots over the surfaces and inside the micro-fissures, mechanical stress, excretion of acid substance over the substratum which leads to chemical degradation of stone surface, etc)
This form of biodeterioration is particularly evident in areas facing north (more stable favorable microclimate)

An example of biological patina over the stone surface

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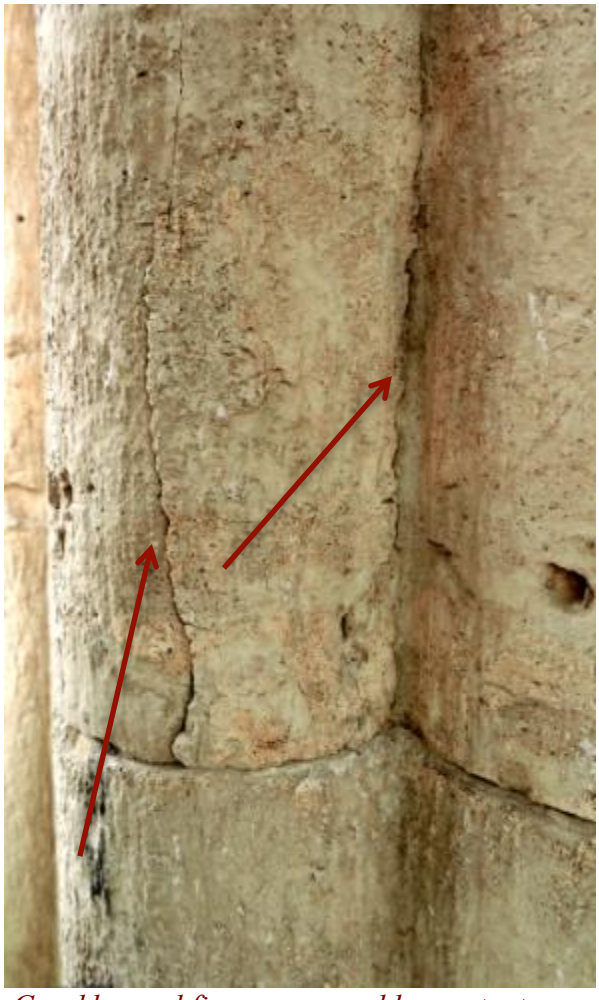
Weeds rooted in joints lacking bedding mortar.

A general reduction and/or total lack of bedding mortar among the stones can be observed: this facilitates the formation of preferential ways for seepage of rain water, causes washing away and formation of physical decay (for instance the disruptive action of water in seasonal cycles of frost and thaw) and chemical deterioration caused by natural and artificial "pollutants" carried by water…but this is not is not the only problem!

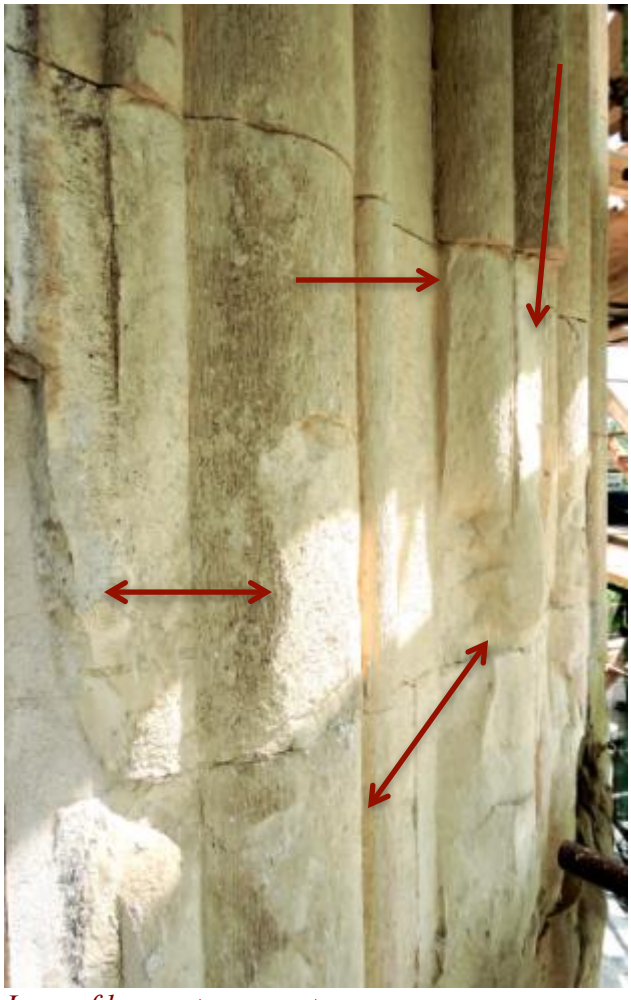
The phenomenon is particularly severe due to the construction technique of the walls.

Among the ashlars there is a very thin joint; usually each ashlar shows a regular contact line towards the corners on the front side while it is slightly concave inside to contain the right amount of bedding mortar.

The partial or total loss of this bedding mortar, occurring over the centuries, puts the surfaces of the overlapping ashlars into direct contact; the mortar is no more there to absorb the compression and bending forces; the stress concentrated in points of contact causes crackles, cracks and fissures that fracture the stone, then causing detachment and fall of stone parts.



Crackles and fissures caused by contact among ashlars.



Loss of large stone parts

Many areas of the dome drum are affected by this pathology and are characterized by a typical web of crackles and fissures, by parts still *in situ* though unsafe and by a diffuse loss of original material either in wall surfaces or in decorated parts (typical lacunas at the corners of ashlars and delaminations of the modillion mouldings can be seen, etc.).

The alarming structural damages in the upper part of the dome drum (for instance crackles and fissures in the middle of the window arches), caused by static problems of the dome, have been structurally restored recently by hooping the dome, thus decreasing inappropriate thrusts and loads on the fractured parts.
The lower part of the dome drum, just above the roofs of the lower building, shows a severe decay, likely caused by a specific event that affected this architectural part in the past centuries (fire of shelters?): for the time being no archive documents have been found. Stone surfaces are widely covered by a concrete mortar; under this layer the stone is cracked and fragmented, sometimes lacking cohesion.

The concrete mortar, laid in the past with the aim to preserve the decayed ashlars, contributed, on the contrary, to worsen conservation: the migration of soluble salts contained in concrete and its elastic modulus which differs from the original stone, greatly increased disintegration over and beneath the surface and fragmentation of ashlars.

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Two specific problems connected with the recent placing of oak frames can be observed. Due to the lack of a framework in the wooden frames a deleterious disjointing between wood and stone allows seepage of rain water. Moreover, since the time in which the window frames were put in place, one year ag, the insufficiently seasoned wood caused a very widespread leakage of tannin over the stone surfaces.

Some windows were in-filled in ancient times (inner wall paintings) with bricks covered by a layer of mortar. Plaster shows decay: biological growth, crackles and fissures, lack of adhesion to the wall, detachments, loss of material and lacunas. The visible bricks show weak cohesion, pulverization, erosion and loss of material.

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2. PROPOSAL FOR INTERVENTION

The various operations, which will be related to an accurate conservation intervention, are described in brief.
- To treat microflora, a specific biocide (4% solution of Benzalkonium Chloride in demineralized water) will be sprayed over the surfaces. After 20 days, the time needed to complete the biocide action, devitalized vegetation will be removed by a delicate washing of the surface with the aid of soft nylon and/or sorghum brushes. Treated surfaces should not be washed away by rain for at least three days after application of biocide; in case of rain the application should be repeated.
- Devitalization of weeds (such as *Parietara*) by a specific glifosate based herbicide (such as "Rodeo Gold" Monsanto). After 20 days, the time needed to complete the biocide action, devitalized weeds will be removed.
- Reassembling of detached and/or removable small parts (up to approximately 500 grams) by means of a high concentration solution of reversible acrylic adhesive (Paraloid B72 50 % in Ethylacetate).
- Reassembling of detached and/or removable medium size/large parts (heavier than 500 grams), with specific low elastic modulus epoxy resin ("Epo155" CTS).
If needed, insertion of a mechanic anchorage (stainless steel reinforcement micro-pivot, Ø mm 4) after drilling a slot with a rotating drill (never a hammer drill) .
- Refurbishment of lacks of adhesion, de-laminations and detached parts by injections of natural hydraulic lime grout (NHL5 + ventilated hydraulic aggregates such as cocciopesto or pozzolana). Should the space to be filled too thin to allow penetration and flow of grout detachments, injections of nanosilica will be carried out with or without ventilated aggregates.
- Detached parts thicker than 3-4 cm will be anchored, after injection of grout, with a pretensioned reinforcement fiberglass micro-pivot (Fibrenet .) and reversible acrylic adhesive resin (Paraloid B72 40 % in Ethylacetate + ventilated aggregates).
- Mechanical removal of concrete fillings which are not suitable for an appropriate conservation.
- Refurbishment of lack of cohesion of stone (lower part of the dome drum) and of bricks by an inorganic consolidant (Ethylsilicate Wacker OH 100), injected with a syringe into all crackles, cracks and fissures and applied with a brush until saturation of the stone. Thirty days are needed to Ethylsilicate to complete consolidation; it is also important to avoid that, during the first 15 days after application, the surfaces are exposed to rain and control that the temperature are within 15° and 30 ° Celsius.

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- Refurbishment of lack of adhesion between plaster and bricks by injections of natural hydraulic lime with aggregates (NHL5 + ventilated aggregates, water and alcohol 1: 1)
- In places where ashlars are in direct contact, separation, by means of a thin diamond disk, between two elements to create a suitable mortar joint (it is important to get a suitable space into the joints without altering the building technique) 2 mm.
- Replacement of bedding lime mortar with suitable color and granulometry mortar (lime putty, river sand, suitable aggregates, 1: 3) after deep injection of natural hydraulic lime grout NHL5 + ventilated aggregates, such as cocciopesto or pozzolana 1: 1)

This operation allows to fill every void into the deep joints among ashlars, thus contributing to their stabilization. The injections should be carried out keeping fillings into account, that is bedding mortar should adhere to the injected grout when it is still not completely dry.

- Filling of fissures, fractures, plaster borders of in-filled windows, lacunas, with a suitable color and granulometry mortar (lime putty, river sand, suitable aggregates, 1: 3)

Should the crackles to be filled too thin to allow appropriate adhesion, nanosilica with suitably colored ventilated aggregates will be used.

A very precise filling is crucial for a proper conservation of stone, because it gives to the surface a smoothness that allows a suitable flow of rain water avoiding infiltrations and dangerous pooling. It is also important to carry out fillings with a right inclination where cornices or jutting parts show a wrong inclination.

- Reconstruction in reinforced mortar of parts where ashlars that are fundamental for wall stability are missing (for instance if they are a support for the upper ashlar)

In the corners or in the parts to be reconstructed a sort of reinforced support with a fiberglass net G.F.R.P. ("FIBMESH 33x33t96ar" Fibre Net) will be anchored with stainless reinforced steel micro-pivots (4 mm), to support mortar.

The mortar used for reconstruction should have a mechanical resistance similar to the stone (in this case a "bastard" mortar should be used, that is 30% of binder made of white cement and 70% natural hydraulic lime NHL5)

- Sealing the gap between stone and window frames 5 mm below the stone level with "Sikaflex 11FC" Sika, to allow space for a mimetic filling with lime mortar.
- Cleaning. A specific cleaning is not necessary. The grey layer over the stone is due to microflora and deposit of particulate matter; its removal will restore a clean appearance, maintaining the historical patina connected to a physiological aging of materials.

The only areas that need to be cleaned are those stained by tannin leaks. Preliminary tests of cleaning will be carried out with suitable supports (cellulose paste Arbocel 1000 and/or ventilated sepiolite) and suitable buffered solvents and/or surfactants (Ammonium Carbonate, contrad 2000, Hydrogen Peroxide).

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