

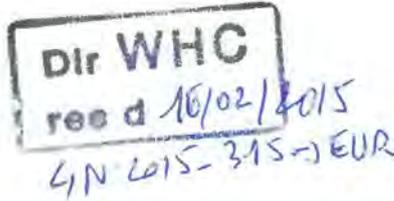


საქართველოს კულტურული მემკვიდრეობის დაცვის ეროვნული სააგენტო
Georgian National Agency for Cultural Heritage Preservation

Alisa

(already sent)

№ 08/13/127



“30” 01 2015 წ.

To: Mr. Kishore Rao,
Director
World Heritage Centre

7, Place de Fontenoy
75352, Paris 07 SP

Dear Mr. Rao,

In conformity with the decisions of the 38th session of the World Heritage Committee, held in Doha, Qatar in 2014, I would like to present for your consideration the State of Conservation report of the Bagrati Cathedral and Gelati Monastery World Heritage Site as well as the State of Conservation and Progress Reports of the Historical Monuments of Mtskheta World Heritage Site.

On behalf of the National Agency for Cultural Heritage Preservation of Georgia, I would like to reiterate the deep commitment to the implementation of the World Heritage Convention.

Please, accept the assurance of my highest consideration.

Nikoloz Antidze
Director General

Annex 1: SoC report Historical Monuments of Mtskheta
Annex 2: Progress Report Historical Monuments of Mtskheta
Annex 3: SoC report Bagrati cathedral and Gelati Monastery

Bagrati Cathedral and Gelati Monastery, C 710

The present folder contains:

1. State of Conservation Report of the Bagrati Cathedral and Gelati Monastery, C710, Georgia, 2015

Annexes provided on CD:

Annex 1: Metodology report about conservation of building stones of the Early 12th-Century Church of the Virgin at Gelati Monastery in Kutaisi – Stefano Volta

Annex 2: Engineering Technical Report

Annex 3: Technical Report of the Restoration Works

2. Executive Summery on the State of Conservation

Prepared by:

The National Agency for Cultural Heritage

Preservation of Georgia

5, Tabukashvili str, Tbilisi, 0105, Georgia

www.heritagesites.ge



Date inscribed: 1994

Date of report: 30/01/2015

Criteria: (iv)

City of Kutaisi, Region of Imereti

N42 15 43.992 E42 42 59.004

Executive Summary on the State of Conservation

Response from the State Party to the World Heritage Committee's Decision(s)

- a. Corrective measures taken by the State Party in reply to the World Heritage Committee's Decision(s):

Decision: 37 COM 7A.32	State Party response
<u>Encourages</u> the State Party to continue to implement all relevant conservation measures regarding Gelati Monastery, including elaboration of a management plan.	The Management Plan is under preparation by the State Party is planned to be completed in May, 2015. The draft Management Plan was submitted to the WHC for consideration in January 2014.
<u>Requests</u> the State Party to submit, by 1 February 2014, a request for a major boundary modification for the property to allow Gelati Monastery to justify the criterion on its own.	The State party elaborated the Major Boundary Modification Document and submitted to the WHC for consideration in January 2014.
<u>Also encourages</u> the State Party to seek the advice of the World Heritage Centre and the Advisory Bodies in developing the boundary modification and submit the draft to the World Heritage Centre for comments by the Advisory Bodies, by 30 September 2013.	An international expert - Mr. Christopher Young was invited by the State Party to assist the local working group in the process elaboration both Major Boundary Modification and Management Plan for the property.

- b. Other issues:

- The elaboration of the draft national law on World Heritage properties in the scope of the EU funded project TWINNING "Support to the institutional development of the National Agency for Cultural Heritage Preservation of Georgia" (to be submitted to the WHC for comments in April 2015).
- The extended Buffer Zone of Gelati Monastery was adopted by the decree of the Minister of Culture and Monuments Protection of Georgia on 09.01.2014. The map of the Buffer Zone was submitted to the WHC together with the Boundary Modification document.
- According to the Georgian legislation, after the extension of the Buffer Zone of Gelati Monastery all the projects of the new constructions within the Buffer Zone shall be approved by the Cultural

Heritage Council of the NACHPG. The NACHPG now is in full control of the development processes in the area.

- In the framework of the Gelati Monastery Conservation Plan, submitted to the WHC in 2010, with the funding of the US Ambassadors Fund for Cultural Preservation a 3-year project was launched in 2014 that implies: Architectural Rehabilitation of the Church of the Virgin and Emergency Conservation Works on Mural Painting in the Dome of the Church of the Virgin.
- To assess the current state of the implemented works, upon the initiative of the NACHPG and the World Bank, Dr. Alkiviades Prepis, ICOMOS and prof. eng. Giorgio Crocci undertook the evaluation mission in January, 2015. The experts gave positive preliminary assessment on the conservation works. The final report and recommendations will be provided by 16th of February, 2015 based on the contract signed between the NACHPG and ICOMOS.
- Conservation and restoration works will be continued and extended from 2015 with the World Bank funding through the Imereti Regional Development Project.
- Construction of the Visitor Centre outside Gelati Monastery as agreed with the WHC and Advisory Bodies in 2012 will start in 2015 with the World Bank funding.
- With the NACHPG funds, rehabilitation of St. Nicos stairs and platform and preservation works of the East wall of the King David's gate were conducted. During the earth works carried out at the King David's gate interesting archaeological materials were revealed. The archaeological excavations will be continued to further clarify the historical data related to the monastery.
- The physical arrangement of the Bagrati Cathedral floor according to the design elaborated in 2013 and approved by the Cultural Heritage Council of the NACHPG was completed in 2014.
- In the scope of the evaluation of the Major Boundary Modification, ICOMOS undertook the technical evaluation mission on Gelati Monastery in October, 2014. Dr. Bernhard Furrer, ICOMOS expert studied on-site all the aspects related to authenticity, integrity, conservation, protection and management of the property and held meetings with different stakeholders.
- The TWINNING project provided trainings for site managers and museum-reserves aimed at strengthening knowledge and skills of the NACHPG staff.

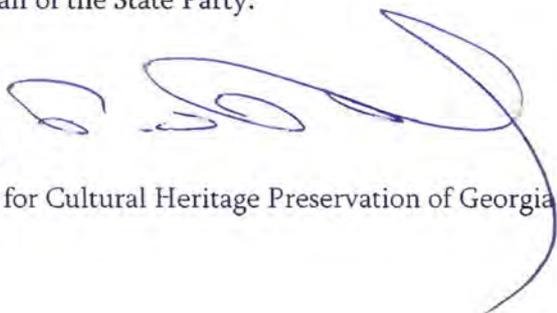
For more information see the State of Conservation Report 2014.

Signature on behalf of the State Party:

Nikoloz Antidze

Director General

National Agency for Cultural Heritage Preservation of Georgia



Bagrati Cathedral and Gelati Monastery State of Conservation Report

National Agency for Cultural Heritage Preservation of Georgia

January 2015

This Report on the State of Conservation of the Bagrati Cathedral and Gelati Monastery (C 710, Georgia) has been prepared by the National Agency for Cultural Heritage Preservation of Georgia for the World Heritage Centre so that the World Heritage Committee may examine the state of conservation of the property at its 39th session in Bonn, Germany in 2015.

INTRODUCTION

State Party	Name of the Property	Date of Inscription	Criteria	Organization responsible for the preparation of the report	Date of Report
Georgia	Bagrati Cathedral and Gelati Monastery	1994	C (iv)	National Agency for Cultural Heritage Preservation of Georgia	2015

1. SIGNATURE ON BEHALF OF STATE PARTY

Nikoloz Antidze
Director General
National Agency for Cultural Heritage Preservation of Georgia



2. STATEMENT OF SIGNIFICANCE

2.1 AS PROVIDED BY STATE PARTY IN THE NOMINATION DOSSIER

2.1.1 Gelati Monastery

“Gelati ensemble is a well preserved historical ensemble. It is of special importance for its architecture, mosaics, wall paintings, enamel and metal work. Gelati was not only a monastery, but a scientific and educational centre as well. The academy established in the Monastery was one of the most important cultural centres of ancient Georgia. By virtue of its high architectural quality and the outstanding examples of artwork that it houses, Gelati Monastery is a unique treasure of Georgian culture, and a rare example of the world culture”.

2.1.2 Bagrati Cathedral

“The outer appearance of the building is monumental and grand, varied and dynamic. Ornamental decoration contributes to the picturesqueness of the cathedral. The building amazes and fascinates the viewer by perfect proportions, free and perfect execution of the mouldings, ornaments, arches, light constructions. Bagrati cathedral ornamentation makes it possible to trace the evolution undergone by Georgian architectural ornament in less than half a century; this ornamentation is an excellent sample of the world architectural plastics. High artistic value of Bagrati cathedral goes far beyond the local significance. It is one of the best monuments of the medieval Christian architecture”.

2.2 AS PROVIDED IN ICOMOS EVALUATION

“The two monuments presented in this report belong to the period of flowering of middle age Georgian feudal monarchy. Due to the strategic location on the crossroad of Eastern and Western worlds, the country created its own stylistic idiom. Both of the monuments represent the brightest outbreaks of this idiom in the context of the royal capital of Georgian kingdom.

[...] Detailed maps showing the areas proposed for inscription and the buffer zones, which had been omitted from the nomination dossier, were supplied to the mission. [...]

Recommendation: That this property be inscribed on the World Heritage List on the basis of criterion iv:

Criterion iv. Bagrati Cathedral and Gelati Monastery represent the highest flowering of the architecture of medieval Georgia”.

3. STATEMENT OF AUTHENTICITY/INTEGRITY

3.1 EVALUATION OF THE AUTHENTICITY AT THE TIME OF INSCRIPTION

“Bagrati Cathedral nowadays is a ruin and may be considered *ipso facto* completely authentic. Gelati Monastery has been in continuous use since its construction, so it inevitably contains certain elements introduced before the modern philosophy of conservation was formulated. Nevertheless, its authenticity and integrity is generally preserved”.

3.2 PRESENT EVALUATION OF THE AUTHENTICITY/INTEGRITY

3.2.1 Bagrati Cathedral

As stated by the World Heritage Committee 37th session (37COM 7A.32, Phnom Penh, 2013) due to the inappropriate rehabilitation, the authenticity of Bagrati Cathedral has been irreversibly compromised and that it no longer contributes to the justification for the criterion for which the property was inscribed. Following the recommendation by the World Heritage Committee the State Party has submitted the Major Boundary Modification for the property to allow Gelati Monastery to justify the criterion on its own.

3.2.2 Gelati Monastery

The authenticity of the Monastery is fully preserved. The Gelati Monastery Rehabilitation Project – commonly known as Conservation Master Plan, guides most important rehabilitation works since 2008. The Gelati Monastery Complex Rehabilitation Project has been the basis for the preservation of the authenticity of the monument, restoration and rehabilitation of all its components and the same time its presentation to visitors and its utilization by the clergy.

The Gelati Monastery Rehabilitation Project, and all following projects based on it were duly provided to the WHC for evaluation in 2009-2013.

4. MANAGEMENT

4.1 LEGAL FRAMEWORK

- a. The legal framework regulating the issues related to Bagrati Cathedral WHS (the laws, the Concordat, the protection zones) is described in details in the SoC report of 2013, and is therefore omitted here.
- b. In 2013-2014 the major step forward was the preparation and legal adoption of the extended the buffer zone of Gelati monastery WHS. The buffer zone was adopted by the decree of the Minister of Culture and Monuments Protection on 09.01.2014. The map of extended buffer zone was submitted together with the Boundary Modification document as shown in fig. 1 below.



4.2 MANAGEMENT PLAN

The Conservation Master Plan for Gelati Monastery provides guidance for the rehabilitation actions within the property boundaries since 2008. Despite not having a legal status, it provides a formal framework to implement conservation works on the site on a sustainable basis. The Conservation Master Plan will be updated in 2015 in order to reflect new realities and meet the current and future needs of the Gelati Monastery Complex.

The Management Plan is under preparation by the State Party. The Chubinashvili National Research Centre for Georgian Art History and Monuments Protection was commissioned by the Ministry of Culture and Monuments Protection to prepare the Boundary Modification Document for the Bagrati Cathedral and Gelati Monastery and the Management Plan for the Gelati Monastery. An international expert - Mr. Christopher Young was hired by the Ministry of Culture and Monuments Protection to assist the local working group in the process. As a result of this collaboration the draft Management Plan was submitted to the WHC for consideration together with the Major Boundary Modification Document in January 2014.

The work on the Management Plan is in progress and is planned to be completed in May, 2015. Since 2014 the activity is funded by the World Bank in scopes of the Imereti Regional Development Program run with the World Bank funding by the Georgian Government.

In the Management Plan elaboration process, the NACHPG holds regular coordination meetings with the participation of all the stakeholders aimed to ensure collaboration among them and to monitor and discuss the progress of the working group.

The following stakeholders are involved in the discussions:

- Ministry of Culture and Monuments Protection of Georgia
- Ministry of Economy and Sustainable Development of Georgia
- Patriarchate of Georgia
- World Bank
- Municipal Development Fund of Georgia
- National Tourism Administration of Georgia
- Agency of Protected Areas
- ICOMOS Georgia
- Ap. Kutateladze Tbilisi State Academy of Fine Arts
- Georgian Arts and Culture Centre
- Chubinashvili National Research Centre for Georgian Art History and Monuments Protection

The new draft document, finalized in May 2015 will be submitted to the WHC for further comments.

4.3 NATIONAL INSTITUTION

The management of the WH sites at the national level is entitled to the National Agency for Cultural Heritage Preservation of Georgia – the legal entity under the Ministry of Culture and Monuments Protection of Georgia.

The UNESCO and International Relations Unit of the Agency, facilitates co-ordination of the processes at the national level related to the WH sites, elaborates annual programs and overall strategy related to WH sites as well as the issues related to the national tentative list.

The NACHPG is responsible for monitoring and maintaining good state of conservation of the site, providing proper methodology for interventions and issuing permits, providing a general management framework as well as visitor facilities and information.

In 2013, The National Agency for Cultural Heritage Preservation of Georgia became the beneficiary of the EU funded TWINNING project "Support to the institutional development of the National Agency for Cultural Heritage Preservation of Georgia" with Ministry for Cultural Heritage and Activities of Italy as the Member State Partner and the Heritage Agency of Denmark as the Junior Member State Partner. The key purpose of the Project is to improve governance in the field of Cultural Heritage Protection through strengthening the capacities of the National Agency for Cultural Heritage Preservation (NACHPG), improve the skills and competences of NACHPG staff in the protection and conservation of the cultural heritage and create the sustainable capacity through dedicated training courses, practical on-site experiences and study trips, enhance the legal framework regulating the sector, with the special emphasis on the issues of the Georgian World Heritage. The NACHPG experts together with the TWINNING international experts have prepared draft national Law on World Heritage. The project works further for its finalization before April 2015 to be submitted to the Cabinet of Minister afterwards. The work continues to prepare the further recommendations and outline for the national Cultural Heritage Code.

Address of the institution:

National Agency for Cultural Heritage Preservation of Georgia
N27a Atoneli str, 0105, Tbilisi, Georgia
Director General: Nikoloz Antidze

4.4 MANAGEMENT AGENCY

The local management agency is the Kutaisi Historical Architectural Museum Reserve. It was established in 1981. Following the institutional reform in the field of cultural heritage in 2008, the Kutaisi Historical Architectural Museum-Reserve along with other museum-reserves in the country has become a structural division of the NACHPG.

Address of the institution:

Kutaisi Historical-Architectural Museum-Reserve
Director: Mr. Roland Isakadze
7, Nazarishvili St., Kutaisi, Georgia

The staff of the organization remains as described in the SoC report of 2013.

The manager of the museum-reserve and monitoring specialists are responsible to provide the periodical monitoring and reporting on the Gelati monastery as well as other sites within their territory to the relevant unit of the NACHPG.

The day to day maintenance and operational activities, such are: basic tourist services, cleaning of the territory, etc. are carried out by the monks.

VISTOR CENTRE

Construction of the visitor centre outside the Monastery as agreed with the WHC and advisory bodies in 2012 will start in 2015. The project is funded by the World Bank. The visitor centre will operate under the Kutaisi Historical-Architectural Museum-Reserve.

5. NATIONAL INVENTORY

The Bagrati Cathedral and Gelati Monastery are registered as Listed Properties according to the Georgian Legislation. Following the detailed inventory in 2008 the Registration Card and a detailed documentation for the site were developed, which are the mandatory documents for Listed Properties provided by legislation. They contain information on the state of conservation of the monument, location, description, etc. The documents are kept in the archive of the NACHPG.

6. CAPACITY BUILDING

One of the main objectives of the TWINNING project is to improve governance in the field of cultural heritage protection through strengthening capacities of the NACHPG. In the framework of the trainings to Support Strategic Change aimed at strengthening knowledge and skills of the NACHPG central level staff, site managers, museum-reserves' staff and relevant stakeholders, a wide range of training courses were implemented throughout 2014, including:

- a) Training on Strengthening Museum-Reserve Activities
- b) Training on Site and Museum Collection Management
- c) Training in Exhibition Design and Site Presentation
- d) Seminar on International Convention Concerning the Protection of the World Cultural and Natural Heritage

7. FACTORS AFFECTING THE PROPERTY

Gelati village does not face intensive development pressures. The quarrying activity that is carried out in the area does not have a direct physical impact on the site. A stone quarry that is located particularly close impacts the site indirectly by circulation of heavy trucks and resulting noise and pollution. Different solutions are suggested in the master plan to solve this issue, such as re-routing the road to the quarry. In January 2015 the Memorandum on Mutual Cooperation was signed between the NACHPG and the mining companies which hold the licenses for mining activities in the area with the aim to limit the movement of heavy vehicles in Gelati Monastery adjacent area (Monday-Friday from 10:00 to 19:00; Saturday-Sunday and during religious feasts for 24 hours per day), ensure save pedestrian traffic for visitors of Gelaty Monastery and create appropriate conditions for touristic infrastructure arrangements.

Gelati Monastery is one of the most visited site in Georgia. Since the collapse of the Soviet regime, the restored monastic function has also added to the site significant number of visitors from all over Georgia. The religious community, composed of about 20 monks resides on the territory of the site. For the moment, the master Plan provides special solution for the issue, by introducing the different zones for visitors and monks and providing clear signage.

The Management Plan of the complex foresees the Visitors Management Action Plans that will improve physical access, introduce different touristic routes throughout the new buffer zone that offers rich diversity of cultural and natural heritage and creates possibility to relieve the tourist pressure from the Monastery at the peak periods (see the map below).

8. MONITORING

National Agency for Cultural Heritage Preservation of Georgia, through its structural unit - Kutaisi Historical Architectural Museum-Reserve, implements the periodic monitoring of the property.

On the basis of the short periodical reports submitted from Kutaisi Museum Reserve as well as other structural subdivisions of the NACHPG, the annual report on state of conservation of the property is compiled by the UNESCO and International Relations Unit at the Agency and submitted to the WHC.

Unified National GIS Database for Cultural Heritage – has been under elaboration with the assistance of the Norwegian Directorate for Cultural Heritage and the Norwegian Ministry of Foreign Affairs since 2013. The online tools of the database will facilitate more intensive and effective exchange of information from Museum-Reserves to the head office of the NACHPG, and, thus more efficient management and monitoring of the sites.

PROTECTION AND CONSERVATION

8.1 PROTECTION ZONES

Gelati Monastery and Bagrati Cathedral are protected by the individual protection zones defined by the Law on Cultural Heritage.

In 2012 in the scope of the Major Boundary Modification the state took an initiative to study in depth the need for a buffer zone for Gelati Monastery. As a result the proposal for extension of the boundary of the visual protection area of Gelati Monastery was prepared and submitted to the Minister of Culture and Monuments Protection for consideration and approval. It was approved on January 9, 2014, after consultations with the Georgian Orthodox Church. The map was submitted to the WHC together with the Boundary Modification document in 2014.

In accordance with the Georgian legislation, after the extension of the buffer zone of Gelati Monastery (adopted by the decree of the Minister of Culture and Monuments Protection on 09.01.2014) all the projects of new constructions within the visual protection area of Gelati Monastery require the approval of the Cultural Heritage Council – Section for Cultural Heritage Protected Zones – of the NACHPG, after their submission from the Tkibuli Municipality. Though the new constructions activities are very low in the area, the Agency is in full control of the process and is able to monitor and properly plan the development processes.

8.2 CONSERVATION WORKS CARRIED OUT IN 2015

Gelati Monastery

The Gelati Monastery Conservation Master Plan, presented to the WHC in 2010, remains the guiding document for implementing and planning the long term rehabilitation and conservation of the property.

Along with the state funding, since 2014 the three year project (2014-2016) has been launched by the Georgian Arts and Culture Centre and Tbilisi State Academy of Fine Arts with the funding of the US Ambassadors Fund for Cultural Preservation, with total amount as of 600 000 USD. The following activities have been implemented in scopes of the project:

- a) Architectural Rehabilitation of the Church of the Virgin
- b) Emergency Conservation Works on Mural painting in the Dome of the Church of the Virgin

These activities are in full conformity with the recommendations of the Conservation Master Plan and are being closely monitored by the NACHPG to ensure the highest quality of interventions.

The implementation of the Architectural Rehabilitation of the Church of the Virgin at Gelati Monastery started in 2013. The studies and preparatory works included following activities:

- Archaeological and Art Historian studies
- Construction of the scaffolding on the exterior and in the interior of the Church of the Virgin at Gelati Monastery
- Examination of under roofing structure
- Measurement of the dome and preparation of the model for the development of ceramic tiles
- Examination of current condition of the dome structure

Based on conducted studies as well as analyses of the past archeological, geological studies the methodology for the rehabilitation of the roofing have been elaborated in cooperation with the international consultant Prof. Stefano Volta (*see annex1:Methodology Report of Building Stones of the Early 12th-century Church of the Virgin at Gelati Monastery in Kutaisi*). The physical works on site started in 2014 and included the following activities (*see annex 2: Engineering Technical Report and Annex 3: Technical Report of the Restoration Works*):

- Arrangement of temporary roofing
- The cleaning of the stone slabs inside the old roofing of the dome
- Creation of special belt to reinforce the dome structure
- Treatment of old wooden beams with Benzalkonium Chloride
- Additions of new oak beam supplements to the roof construction were needed, to meet the requirement for ceramic tile roofing
- Reconstruction of stone cornices of the dome by the lime mortar
- The missing fragments of the cornices filled by following methods:
- The existing cornices papered for the fixation of new elements
- The holes for the anchoring prepared and the stainless steel anchors prepared
- Installation of stainless steel anchors with special two component glue
- Preparation of new elements of cornices
- Installation of new fragments of cornices
- The models of ceramic tiles have been prepared
- The ceramic tiles have been produced in quantity for 280 sq.m.
- The old windows have been replaces by new wooden ones

For the end of the season the wooden rafters' structure was covered with wooden panels and hydro-insulation. The on-site conservation works will be resumed on spring 2015.

In the restoration process of the Main Church the question of additional consolidation of the dome was put on the agenda (*see annex 2*). In order to assess the current state of the carried out interventions, upon the initiative of the NACHPG and the World Bank, Dr. Alkiviades Prepis, ICOMOS and Prof. Eng. Giorgio Crocci undertook the evaluation mission on 22-25th of January, 2015. The experts held meeting with the working group of the Rehabilitation Project, got acquainted with the working process of laboratory and glazed tiles atelier and visited Gelaty Monastery complex and got positive preliminary assessment on the implemented conservation works. The experts will provide final assessment and recommendations on the issue by 16th of February, 2015 February based on the contract signed between the NACHPG and ICOMOS.

Rehabilitation of St. Nicolas's stairs and platform:

Before



After



Preservation works of the East wall of the King David's gate

Before



After



Bagrati Cathedral

The physical arrangement of the Bagrati Cathedral floor, according to the design elaborated in 2013 and approved by the Cultural Heritage Council of the NACHPG was completed in 2014.

Before



After



8. MONITORING

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- a) Architectural Rehabilitation of the Church of the Virgin
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10. CONCLUSIONS

The conclusions presented below aimed at contributing to the analysis which will facilitate to the Advisory Body and the Secretariat the preparation of the Committee draft decision.

Strengths

- The Major Boundary Modification for the property is finalized and submitted to the WHC
- Significant Funds are allocated from international donors as well as the State Party for the conservation and rehabilitation works of Gelati Monastery
- The Best international and local experts are mobilized to solve the conservation and rehabilitation issues
- The Management Plan preparation is in progress
- Visitor centre is being constructed as approved by the ICOMOS and WHC
- Further visitor routes are designed to relieve the tourist pressure from the site
- The developments in the buffer zone are legally controlled by the local authority and the NACHPG
- The update of the Conservation Master Plan is funded by the NACHPG in 2015
- Trainings available for site managers and museum-reserve staff in the framework of the TWINNING project

Weaknesses

Spett.le

GACC Georgian Arts&Culture Center,

7, N.Nikoladze Str.

TBILISI, 0108

GEORGIA

Parma, 25 giugno 2014

Metodology report about conservation of building stones of the Early 12th-Century Church of the Virgin at Gelati Monastery in Kutaisi

PREAMBLE

The top external cornice of the dome drum ends with a horizontal stone cantilever that works as a console: half stone is joggled into the wall of the dome extrados and half stone protrudes outward. The form of this stone row is shaped in such a way that either no weight or at least the smallest possible weight from the roof can be loaded on it. In case a weight would be loaded on this cantilever, an equal or even superior weight should counteract it inside the wall stone part to avoid dangerous rotations outward. The new brick shelter which is obviously much heavier of the previous metal sheet shelter should then load its weight in line with the vertical wall of the dome drum. We observed that in sections of walls and roof concerning both current condition and new shelter project, a few contradictions can be pointed out about the position of the planned ring beam: in some sections this ring beam is placed beside the underlying protruding part, in one section it is placed halfway between the underlying vertical wall and the stone protruding part, in another one it loads the weight on the vertical wall. Since the new shelter loads its weight on the ring beam, as one can deduce from the project drawings, we strongly suggest that the new (heavy) shelter weight should load on the underlying vertical wall of the drum, since stones of the cornice cannot be considered as load-bearing elements. We are also perplexed about the connection of the reinforced ring beam to the stone cornice by means of steel anchor bolts. The cornice is currently made of single stones of great dimensions that are able to maintain themselves stable in case of wall movements; connecting the ring beam to the stones would stiffen the system and will then engender risk of new fracture formation. However, if it will be necessary to insert metal elements into the stones (pins, etc) it is essential that holes should be made with core drill or rotary drill, without percussion.

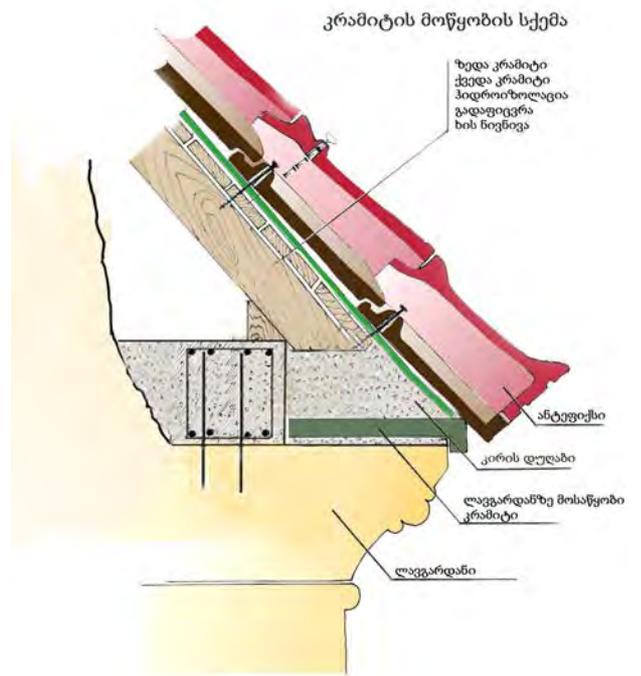
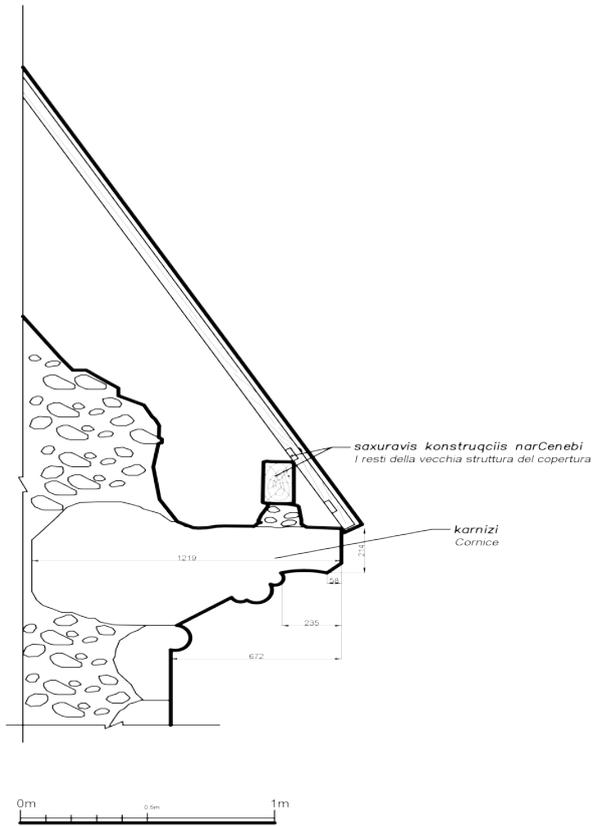
STATE OF CONSERVATION OF THE STONE CORNICE

In the main, the stone of various ashlar is in a good state of conservation. No severe decohesion has been observed.

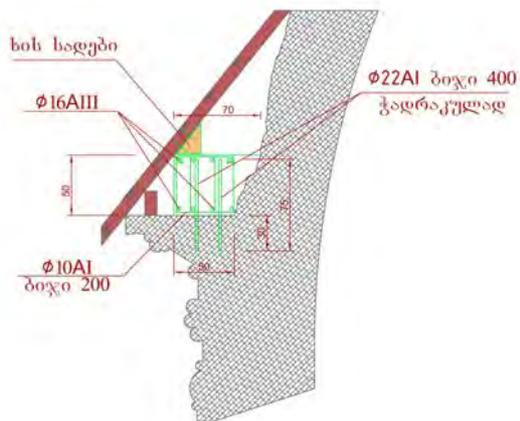
Surfaces show deposits of soil and particulate and slight biodeterioration.

Breaking of some stones is to be considered the most severe decay. It has been observed in various forms. Fractures, fissures, detachments and lacunas. Lacunas are concentrated beside the most external part of molding where shelter was leaning on.

Rotation of some ashlar outward, due to a marked lack of mortar in joints among ashlar has been observed.



გუმბათის ყელის ნიშნულზე
სარტყელის მოწყობის კვანძი



PLAN OF INTERVENTION

As we already stated, the protruding cornice should not be an architectonic load-bearing element of shelter, then our intervention will be exclusively related to conservation, that is restoring the monolithic feature of the variously fractured ashlar, refurbishing current forms of decay and surface deterioration, without replacing missing parts.

Observation of the whole plant explains the reason for this choice: various shelter feet show a high percentage of stone lacunas. Therefore, if a replacement of missing parts would be carried out, the majority of stones (nearly 80%) would not be original...

Planned operations are synthetically described below:

- Treatment of microflora by a specific biocide (4% Aqueous solution of Benzalkonium chloride). Biocide effectiveness is achieved after 20 days.
- After 20 days, surfaces will be delicately washed to remove devitalized biodeteriogens.
- Removal of fragments that can be manually removed and replacement in their original position by means of low elastic modulus epoxy resin (EPO 155 - N/ mm² 1.800 - CTS). Specific additives might be added to epoxy resin to improve its application (for instance: thixotropic agents improving uprightness)
- Large and heavy stone fragments will be fastened with Fiberglass deformed bars to guarantee improved anchorage. Holes for insertion of Fiberglass deformed bars will exclusively be carried out with rotary drills (NO PERCUSSION DRILL) and /or wet diamond core drills.
- Removal of particulate from fissure or fractures with low pressure compressed air and cleaning with acetone injected by a syringe. Cleaning will be continued until clear acetone will get out of fractures. Fissures and fractures will be treated with low pressure compressed air once more to enhance evaporation of solvent.
- Replacement of mortar among ashlar joints with natural lime mortar made of proper color and size aggregates. This operation should be carried out before structural stone consolidation of fractured ashlar to avoid uncontrolled leakage of resin applied into joints.
- Structural consolidation of fissures-fractures of single ashlar with low elastic modulus and low viscosity epoxy resin by means of continuous injection in sealed cell, to avoid air bubbles formation. Fissures-fractures will be previously sealed with a 30% solution of Paraloid B 72 and thermofusibile glue injected through an injection pipe. Both products are 100% reversible. After this preliminary procedure low catalyzed epoxy resin (24h. type CHERECO SYSTEM 102, viscosity at 25°C 230 cps) will be injected. After catalyzed, syringes and pipes will be removed and surfaces cleaned with acetone.
- Filling of fissures and lacunas with natural lime mortar made of proper color and size aggregates. Wide lacunas in ashlar will be filled with mortar to avoid water pooling and to partially restore surface evenness.

Images of system of structural injection are attached.



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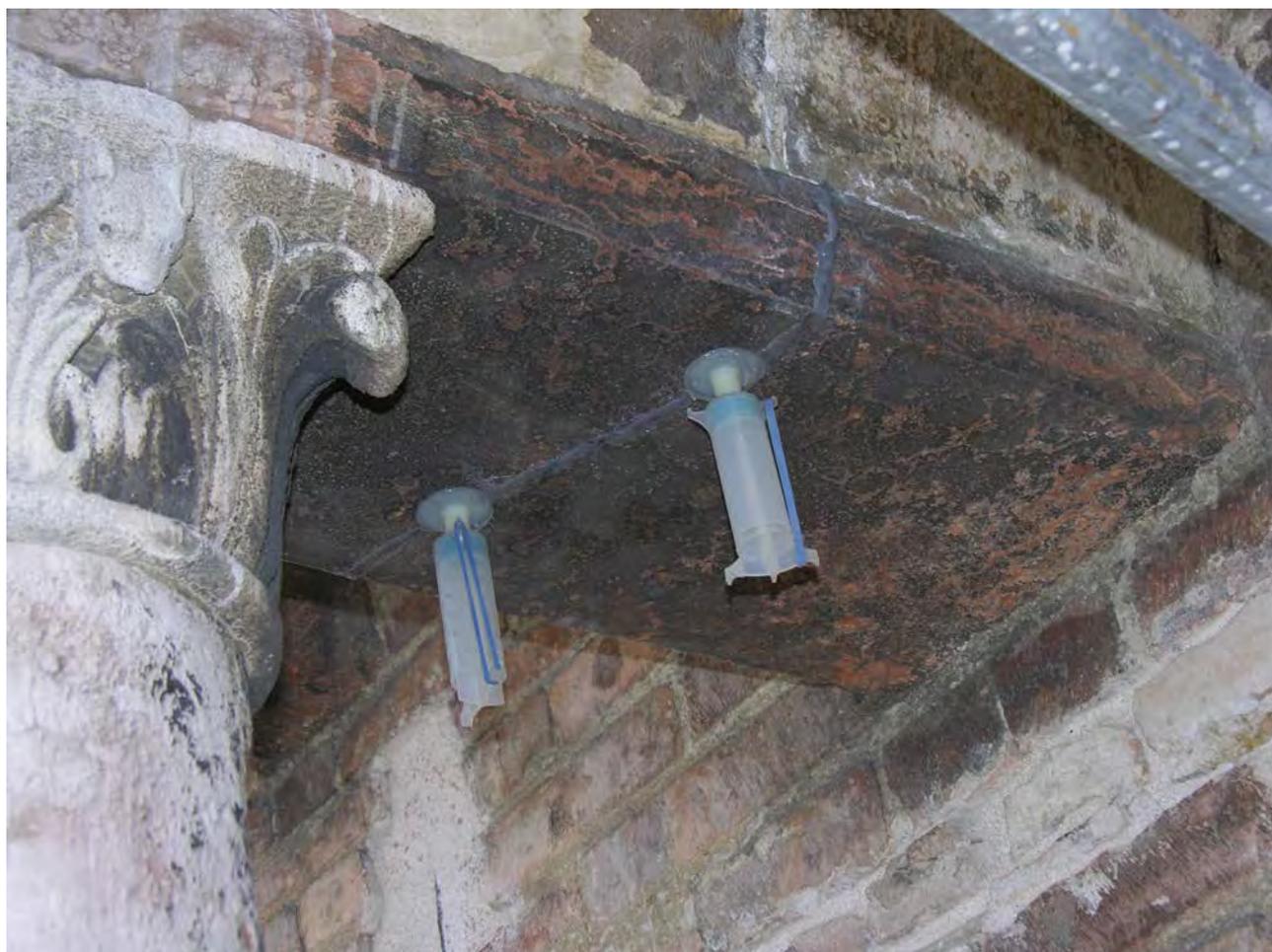
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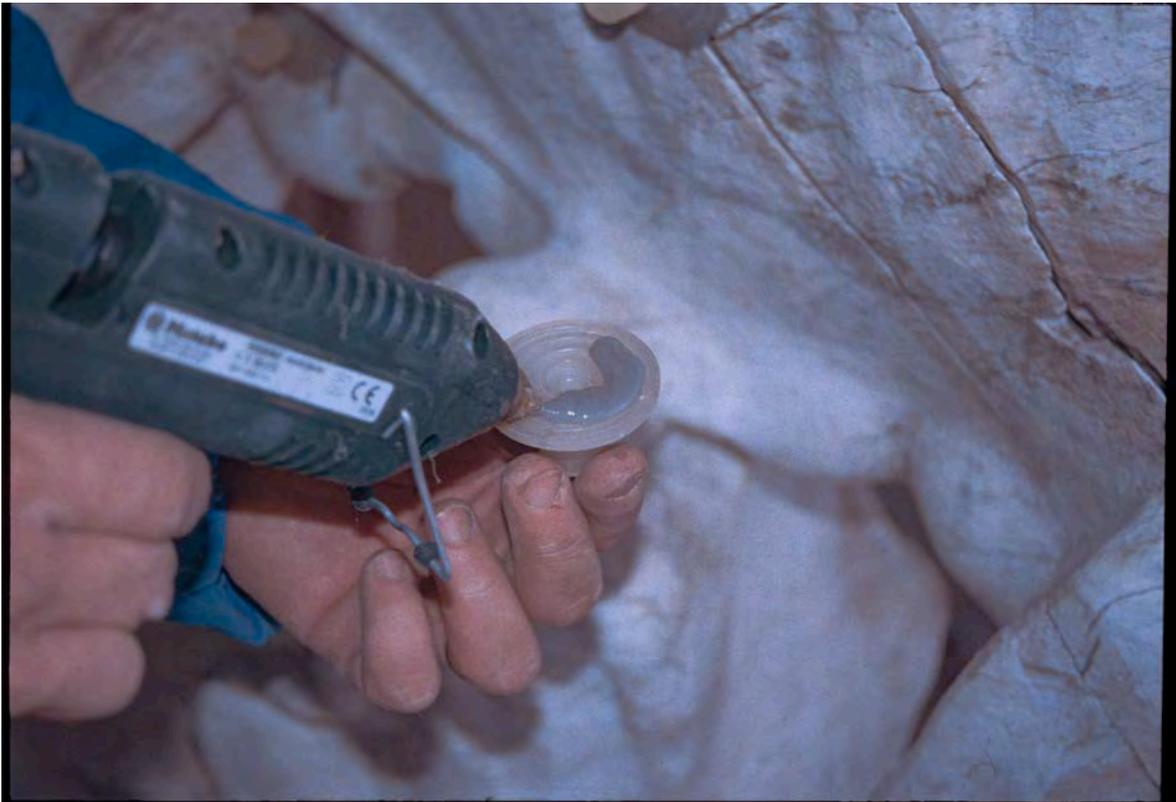
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Architectural Rehabilitation of the Church of the Virgin (12th-18th) at Gelati Monastery

Engineering technical report

1.10.2013 – September 30, 2014



Leading implementing organization: Georgian Arts and Culture center

Partners: Georgian Heritage, Tbilisi State Academy of Arts, Ikorta-2007

Donor: US Ambassadors Fund for cultural Preservation

Grant/ project # S-LMAQM-13-GR-038

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Restoration of the Main Temple of Gelati Monastery Complex

Report of stage One

The Gelati monastery complex is one of the monuments, having the more or less authentic appearance up to present day, though the same cannot be stated about its roofing. Practically, the coverings of all buildings of the complex are represented in solutions, accepted at subsequent alterations, or restorations executed in different periods of XX century, or without covering at all (as, for instance, the building, located on the West part of the complex was before the restoration).

According to the practice, existing in restoration-rehabilitation processes, running 50th of XX century, for roofing of complex main structure, the tin covering was selected (Fig.1), that existed at the restoration-rehabilitation project beginning, and, at some places, exists up to day. The tin, in the traditional style, was located over the wooden rafters. The past period had revealed that such type choice was not reasonable from the functionality point of view.

Fig.1.



The covering at present is amortized, and cannot ensure the safety of the temple frescos, beside this, its extended overhang (approximately, 30-40 cm) is not fit to the structure proportions and represents the danger for the stone cladding. Naturally, the purpose of restoration



Fig.2.

was the water drainage as far as possible from the wall. Unfortunately, for solution of this task mentioned approach revealed not enough, as far as the main part of the church walls is damaged due to atmospheric water. The data of measuring provides the detailed information about the damages, and the height of the temple of the Virgin. The measuring data shows the big number of the stones, damaged due to atmospheric precipitations, is great.

The engineering-structural research, carried out in the project confines, has brought to light, that the existing structure is one of factors, causing the cornice damage, as far as, it due to natural phenomena, permanently suffers vibration (Fig. 2, 3).



Fig. 3.

The initial structure of the coverings of Gelati monastery complex temples is unknown. Though, there are a few sources, providing some information about the covering of complex main buildings. According to information of these sources, the complex main structures, beginning from II half of XVII century up to 60th were covered by the copper, wood lathing, tin, and “iron list”. All these sources are dated by period after second half of XVII century, i.e., after the complex was combusted and significantly damaged at time of attacks in beginning of XVI century.

The only way, to find out about main elements of the complex main structures, there was the execution of archeological works on the complex territory. Drilling of holes of different volumes around the main temple and other structures was planned. Proceeding from the fact, that the concentration of the covering element remainders (tiles, glazed in green, blue and brown colors, nails, fireproof bricks) was particularly notable around the main temple, in the working process there was made the decision about drilling of the additional holes, with the aim of more or less full information.

According to written sources, archive materials, graphical illustrations, available for us on given stage, materials accumulated by employees of the Kutaisi-Gelati museum-national park on the complex territory from time to time (mainly before the 1988), and archeological works, executed in 2008 on the complex territory, there is brought to light, that for the covering of complex separate structures the tiles, glazed in different tonality were used. The samples of these tiles were exhibited in 1988 in the building of former residence of the bishop Gabriel Kikodze. Though, the confirmation, whether the tile fragments are contemporary of the temple construction, or not, is not easy. Tile fragments



have different colors: light blue, greenish-turquoise, green, light brown (Fig. 4).

Fig. 4.

The supposition becomes more reliable, based on the fact, that at the archeological works in one of underground structures the water canal, directed from the South to the north, whose bottom is composed of ribbed tiles of length 38 cm and glazed in green color, was discovered.

Traditionally, in Georgia for the tile laying the lime mortar was used, and can be supposed, that in Gelati this tradition was used, though, the distance between arch central line and roof slope, fixed by the cornice is so large, that the version of under-roof independent structure arises, that, allegedly, was holding the tiles on the lime mortar. Such structures often were used in the church architecture. Unfortunately, the track of such structure is not remained at present.

It is notable, that in South Georgia, exactly this type of roofing is used for the temples Ishkhani (Fig. 5) and Khakhuli (fig. 6).

Based on the analysis of this information, the group of specialists employed in project, decided, the tin roofing of the complex main building to be replaced by the glazed tile roofing.

In spite of the fact, that the tradition of glazed tile manufacturing existed, at present the chain of this tradition is broken. In 2008-2010 we permanently tried to find the group, that managed effectively restoration of this tradition, but without success.



Fig. 5.



Fig. 6.

We attempted to find such tiles abroad, in countries having the tradition of ceramic material glazing (Iran, Italy), but, as far as the form and sizes of the Georgian tile differ from tiles of serial production, all manufacturers,

those buckled down this order, were forced to renew all facilities, that made the cost of tiles unreal. In 2009 the group of specialists was sent on an official business trip to Iran, that is considered as one of countries having great traditions in the glazed tile manufacturing. By the instrumentality of the restoration faculty of the Isfahan Art Academy the needed information and communications were obtained. To visit the corresponding manufactures and workshops was planned, the consultations with the professionals took place, the glazing methodic was mastered, that rendered us great help.

After returning to Georgia, the group, composed of professors of the design faculty of Tbilisi Art Academy – G. Ezikashvili, M. Gabadadze, Architect G. Sosanidze, Doctor of Art Criticism, G. Gagoshidze, begin work in this direction. The process of confrontation of the learned skills and traditions, existing in Georgia, there proved to be labour-intensive. A few tens of material types were prepared, though the result was obtained only to the end of 2010. Based on the archeological material, the seven unique forms of tiles were created, those ensure the tile laying on the dome without the need of the tile fragmentation, and create the integrated fabric.

The obtaining of the palette of colors, which is found in authentic material and implies for each tile not only one color, but existing of the whole range of colors, and which makes the Georgian glazing technique distinguished from the Asian one, proved to be connected to

the great difficulties. Such results were obtained only by manual treatment of tiles. So, each tile, used in monastery complex is made manually.

The product steadiness was twice checked out by the corresponding research institute and the corresponding certificate was granted.

Only after this, in the summer of 2011, there was decided, the Gelati bell tower to be roofed by the new obtained material. After the removal of the tin roofing, in the inner space of the roofing, the emptiness was detected. As far as a tile, comparatively to a tin is more heavy material, with the purpose of the load on dome decreasing, there was decided to arrange the timber structure over the dome for tile laying, and on the structure slope tile covering fulfill using the traditional lime mortar. To avoid the leakage in the case of the roofing possible damage, under the tiles there was made the insulation layer, that ensures full defense of the inner space from the atmospheric precipitations.

The bell tower and Saint Nicholas temple were covered using the tiles of green tonality (Fig.7,8) that represents the mix of rusted copper and ochre tonalities and proportionally to the light variation creates entirely different gamut of colors.

Thanks to carried out investigation and practical works, we were able to begin the work on the main temple. Considering its scale and significance, especially for the complex main temple the tile original forms were elaborated.

Based on the analysis of the glazed tile fragments, obtained in result of the archeological research of Gelati monastery complex, as well as analysis of the coverings of the church-monasteries, constructed in the period of the mentioned temple construction (Oshki, Khakhuli, Doliskana), the typological elements of the tile were elaborated. The laboratorial research was used in order to learn the traditional composition of the archeological glaze and the burning technology. The computer modeling of the dome conical covering was



Fig. 7



Fig. 8

fulfilled; The forms and parameters of separate elements precise; the quarry of clay of the needed fat content was found. The experimental material was prepared and repeatedly tested for steadiness, adhesion, critical temperature mode. When desirable and secured parameters were reached, the number of the separate typological elements were prepared (manual forming, draying out, engobe coating, initial burning, color glazing and final burning).



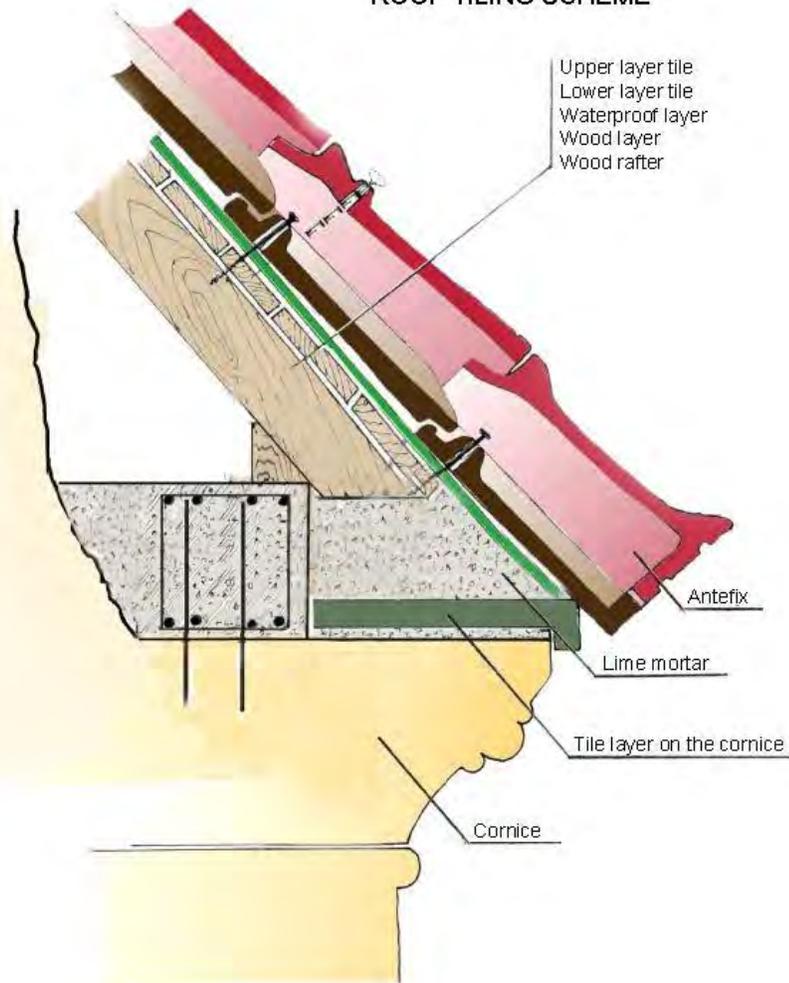
Altogether seven main and six additional elements were elaborated:

- 1 – Flat tile with the wavy front for laying on the cornice;
- 2 – Lower, flat tile with folded sides and rib for the upper tile holding;
- 3 - Lower, flat tile with folded sides in form of the isosceles trapezium;
- 4- Antefix, upper tile with channel and relief front side;
- 5 – Upper basic tile with the channel;
- 6 – Upper ‘pants’, joining two rows of tiles with channel;
- 7 – Conic end of the dome, elements of tile with plural wings, underlying the cross;
- 8-13 –Trapeziform tiles of different sizes for fitting of basic tiles with folded sides.

All tiles are provided with the holes for the fastening.



ROOF TILING SCHEME





The restoration works of the Virgin temple of the Gelati monastery complex began in the November of 2013. In the interior and at the facade the inventory steel scaffolds were arranged. With the aim of investigation of the monument dome and slope, the existing tin roofing was opened. In this process the architects, constructors, art critics, restorers and archeologists participated. Based on results of investigation of fragments of glazed tiles, found in result of opening of the tin coverings on the west arms and late extensions, their real form and color was established. Constructors investigated the structure of dome covering. There was decided, that after certain interference, the retention of this structure is possible.

The monuments of Georgia are strongly damaged due to the earthquake Racha-Imereti, 1991, April. The following temples have suffered the full destruction or heavy damage: Nikortsminda (built in 1010-1014), Ikorta (1072), Tigva (1152), Barakoni (1753). All of them are restored in the end of XX and beginning of XXI century. It is noteworthy, that the damages of these temples are concentrated on the dome neck. For the illustration of damages there is necessary to mention about the temple Kumurdo, located in South district of Georgia and built in 964. Due to earthquake the neck of the dome and all dome is torn away and unrestored up to now.

This excursion was needed to show, that for Georgian monuments the ensuring of the steadiness of the dome, its support ring, dome neck - is the engineering task of the first significance.

The church of the Virgin at Gelati, with dome and cross, is the only exclusion among the temples of this type, that has maintained its own appearance up to now, though, in the roofing of the dome and adjoining slopes the fireproof bricks and colored tiles were replaced, and in the last century the tin was used.

The inner diameter of the main temple dome is considerable enough, equal to 939 cm, the diameter of cone on the cornice ribs – 1315 cm and 839 cm. The dome, as the cornice, are made of limestone, density $\gamma = 2400 \text{ kg/m}^3$, though the dome, as opposed to the cornice, is built out of the quarry-faced trapeziform stones. The height of the dome $H=57 \text{ cm}$, volume $V_{\text{dome}}=9.26 \text{ m}^3$, the mass $G=22.22 \text{ t}$; mean height of the cornice $h_{\text{corn.}}^{\text{mean}} = 163.3 \text{ cm}$; equivalent radius toward the gravity center $R_{\text{corn.}}^{\text{equiv.}} = 476.1 \text{ cm}$; volume of the cornice $V_{\text{corn.}}=23.916 \text{ m}^3$; mass of the cornice $G_{\text{corn.}}=50.22 \text{ t}$. The volume of 16 piers, of the trapeze cross section, located under the cornice $V_{\text{pier}}=1.07 \times 16 \times 4.85=83.4 \text{ m}^3$; mass of piers $G_{\text{pier}}=200.22 \text{ t}$.

On the spring of the current year, when the decision about the existing dome covering dismantling was accepted, and even the scaffold was arranged along the all height, it was found, that the straight arch of the windows, located to the parallel of the diameter on Nord-West-Direction, were cracked, and cracks were passing the row of cornices, as well. But more troubling was the finding of the fact, that in 2007, at fresco restoration works in the temple interior, the cracks were injected by alabaster mixed solution, those at present were separated. There was apparent, that the centuries-old integrity of the cornice was violated.

After opening of the roofing, it was found, that the last covering of the dome was fulfilled very thoroughly. In the structure was used only oak timber material. The ring elements and located over them meridian rafters are fastened very thoroughly. The dome surface was

cleaned out of the dust. The removal of the lime-mortar layer, filling the ends of the rafter and creating the strong layer as between rafters, as in row of cornice, necessary for the roofing arrangement, was thought necessary. After removal of this layer the damage of the cornice become obvious. So the dome support ring needed restoration and strengthening.

The support ring strengthening and restoration of its integrity become the complex task, as far as immediate connection to the dome body was impossible due to one reason: in this case it would be necessary removal of the rafters and rings, that would cause the heavy damage of the timber elements. So, the strengthening of the ring using the steel or wooden hoop falls away.

Finally there was decided to strengthen the support ring, using the reinforced concrete, made of lime mortar, that by means of corresponding anchors would be connected to the cornice and together with the cornice render the needed strength to the support ring. The load of the reinforced concrete on the dome neck had to be 11 *t*, as the existing lime mortar layer was removed the weight only increased up to 7 *t*.

We consider as necessary to bring here the simple case study, to determine the value of expected stresses at earthquake.

The square of the cone covering surface $S=220 \text{ m}^2$, correspondingly, the mass of the tiles $G_{tile}=15.48 \text{ t}$.

The mass of wooden elements (rafters, rings, meridians, planking): $G_{raft.}=1.6 \text{ t}$, $G_{cov.}=17.0 \text{ t}$.

So, the mass of the dome and covering - $G_{Dome} = 22.22 + 17 + 7 = 46.22 \text{ t}$;

Mass of cornice - $G_{corn.} = 50.22 \text{ t}$;

Mass of piers - $G_{piers}=200.22 \text{ t}$.

The normative load on 1 m^2 of the dome $G^n = \frac{46220}{3.14 \times 4.83^2} = 631 \text{ kg/m}^2$;

Snow loading $P_{snow}^H = 79 \text{ kg/m}^2$; $Q^P = 92 \text{ kg/m}^2$;

Maximum circumferential stress – $U = \frac{qR^2}{4} = \frac{792 \times 4.83^2}{4} = 4620 \text{ kg}$;

Maximum meridian stress – $S = \frac{qR}{2} = \frac{792 \times 4.83}{2} = 1913 \text{ kg}$.

The characteristics of piers and all stone masonry:

Strength : grade of stone – 200

mortar – 50

$R = 47 \text{ kgf/cm}^2$

Stiffness: $\alpha = 1500$

$E_0 = 1500 \times 94 = 141,000 \text{ kgf/cm}^2 = 1.410.000 \text{ tf/m}^2$

$E = 0.8 \times 1,410,000 = 1.128.000 \text{ tf/m}^2$.

Gelati Virgin temple is built using the special engineering solution, particularly: Its plan significantly differs from the solutions, elaborated after Tsromi temple construction, and what is very meaningful, the dome neck in west side is supported not on the separate columns, but on the system of the walls strongly connected to each other. The arches, arranged between the walls, are distinguished by the large cross-sections. The cube under the building dome is thus much stiff, that the structure of the dome can be imagined as an independent system with one mass.

The turn of the structure, built on the dome neck (cornice+dome+cone+snow) should be

considered by the radius of inertia of the holding system, i.e. $\rho = \sqrt{\frac{I}{F}} = \sqrt{\frac{258.6}{17.2}} = 3.88$.

The design height is $H = 4.85 + 3.88 = 8.7 \text{ m}$;

Stiffness of the neck $J = 1,128 \times 258.6 = 291.7 \times 10^6$;

$\partial'' = \frac{1+H^2}{2EJ} = 0.13 \times 10^{-6} \omega = \sqrt{\frac{1}{M\delta''}} M = \frac{Q}{g} = 19.9 \omega = 199 \quad T = \frac{2\pi}{\omega} = 0.328$.

The seismic force, according to Georgian standards $S=K_1K_2S_0$, $S_0 = Q_k A \beta \eta K_\psi$;

$$K_1 = 0.25 \quad K_2 = 1.3 \quad K_\psi = 1.5 \quad A = 0,2 \quad \beta \eta = 3;$$

$$S = 0.25 \times 1.3 \times 1.5 \times 0.2 \times 3 \times 200 = 58.8 \text{ t.}$$

Finally, the factors acting on the dome neck are following:

$$\text{Seismic force} - S = 58.500 \text{ kg};$$

$$\text{Bending moment} - M = S \times H = 50,900,000 \text{ kgf}$$

$$\text{Normal force} - N = 296,700 \text{ kg};$$

$$F_I = 172,000 \text{ m}^2;$$

$$W = \frac{\pi D^2}{32} = (1 - \alpha)^4 \times \frac{F_I}{F_0}; \quad \alpha = \frac{d}{D} = 0.85; \quad W = 0.605 \times 8.6 \times 10^6 = 5.23 \times 10^6 \text{ cm}^3;$$

$$e_0 = \frac{M}{N} = 171.55 \text{ cm};$$

$$R = \frac{M}{N} + \frac{N e_0}{W} = 1.729 + 9.732 = 11.45 < 47.$$

So, the dome structure parameters meet the standard requirements with the great reserve.

Proceeding from above stated, in order to retain the dome steadiness, the arrangement of the hoop on the level of the dome bottom was decided. Based on the corresponding calculations the project of structures was elaborated. The works were implemented by the next sequence: the tin covering was removed, the lime mortar was removed in the depth of 20 cm below the cornice level, and width of 65 cm from the dome contour, along the all contour with the length 35 m. For the hoop arrangement the stainless steel bars of diameter 16 mm and 8 mm were used. The cornice stones were drilled, embedded the anchors into the drilled holes and this way the hoop skeleton was arranged. The concrete was prepared of the lime and washed out gravel (The lime was selected of BSF production, range of MasterEmacoS285TIX).

Restorers, before the hoop arrangement, had fulfilled the stone cornice restoration. In the interior, in the dome sphere the cracks were filled.

The old, amortized windows of the conifer were replaced by the new ones, made of the oak material. After the hoop arrangement, the restoration-strengthening works of the existing rafters were executed. They were embedded into the hoop, using the gaskets and anchors. The dome was fully jacketed by the oak wooden material. The wooden material, before the use was treated by the antiseptic solution. Over the dome jacketed surface two layers of hydro-insulation were installed, on which, later, the tile covering should be arranged.

Architectural Rehabilitation of the Church of the Virgin at Gelati Monastery

Technical report of the Restoration Works

July – November 2014



Leading implementing organization: Georgian Arts and Culture center

Partners: Georgian Heritage, Tbilisi State Academy of Arts, Ikorta-2007

Donor: US Ambassadors Fund for cultural Preservation

Grant/ project # S-LMAQM-13-GR-038

Restorers Group

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Alexander Todua

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Giorgi/ George Navrozashvili

Revaz Tatishvili

The aim of the project is rehabilitation of the architectural structure of the church of the Virgin at Gelati monastery complex. One of the main activities is replacement of the existing tin roofing with glazed tiles. To conduct this activity the preliminary rehabilitation of dome cornices was necessary.

The methodology has been elaborated in collaboration with International expert Mr. Stefano Volta. The predefined¹ works have begun by the restorers' team in July 2014. The conducted technical works included:

- **Shortening of the existing wood rafters;**
- **Treatment of the stone surface with Benzalkonium Chloride;**
- **Reconstruction of cornices with stone:**
 - Preparation of existing cornice for fixing new stone details;
 - Drilling of holes for anchoring and preparation of stainless steel anchors;
 - Fixation of stainless steel anchors with a two-component glue (epoxide);
 - Production of new details from stone for cornice reconstruction;
 - Fixation of new stone details on the existing cornice;
- **Damaged cornice reconstruction with lime mortar;**
- **Injection;**

¹ See annex: Stefano Volta, Methodology report about conservation of building stones of the Early 12th Century Church of the Virgin at Gelati Monastery in Kutaisi, 2014

- Shortening of existing wooden rafters:

At the initial stage of the working process the wooden rafters, which being in direct contact were damaging the cornice stones, were shortened.



Fig. Rafters before the shortening

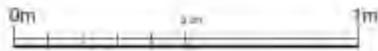
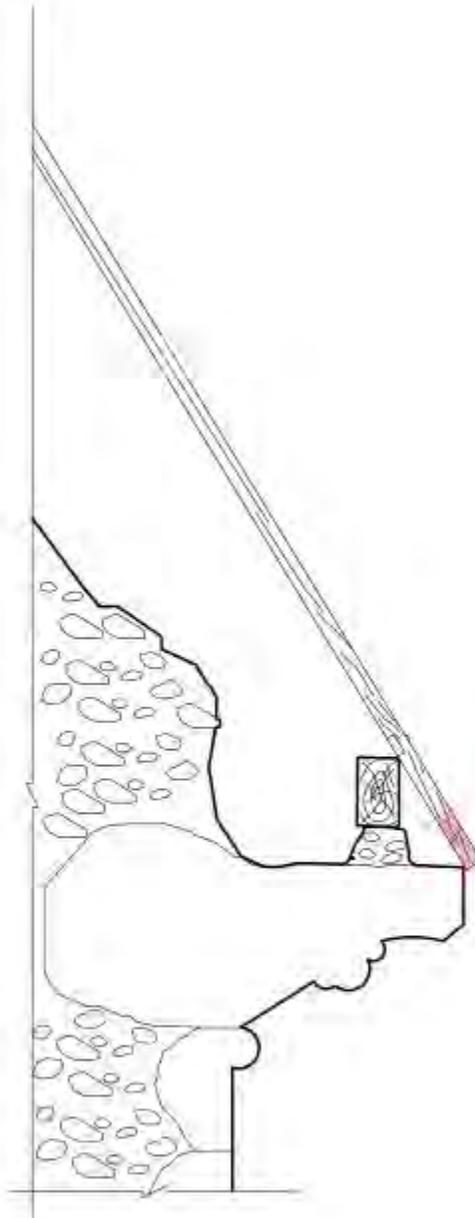


Fig. Stones damaged/ affected by rafters



Fig. Shortened Rafters

Rafters Shortening Scheme



- **The treatment of the stone surface with Benzalkonium Chloride:**

The entire perimeter of the cornice was treated with Benzalkonium chloride against the micro flora. The treatment has been repeated twice during the reporting period.



Fig. Treatment process



Fig. Biological damage

- **Reconstruction of damaged cornices with stone:**
 - Preparation of existing cornice for fixing new stone details.
 - Drilling holes for anchoring and preparation of stainless steel anchors.

The exact points for the anchoring were determined. The wholes for anchoring have drilled, cleaned with air jet and treated with acetone solution. Stainless steel anchors were prepared, cut in individual size and bent with appropriate degrees. Diameter of holes - 14mm, diameter of anchors - 12mm, depth 15-30cm.



Fig. Preparing the holes for anchoring

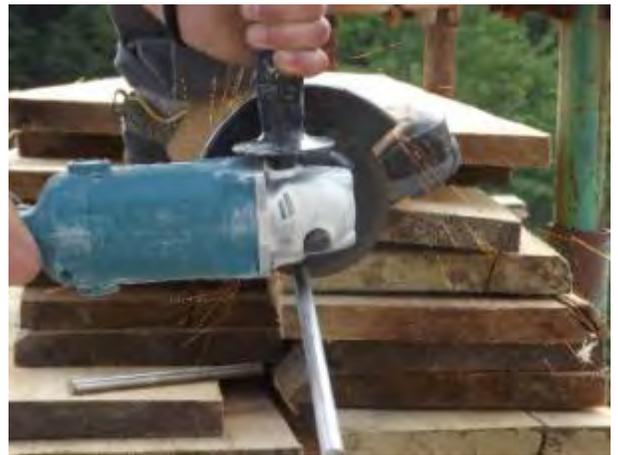


Fig. Preparing anchors

- Fixation of stainless steel anchors with a two-component glue (epoxide);

Stainless steel anchors were fixed in the prepared holes with the two-component glue.



Fig. The working process



Fig. The working process



Fig. Anchors

- Production of new details from stone for cornice reconstruction;

The stone details compatible with cornice stones for each specific section were individually prepared. Holes for anchoring were drilled, surface treated with special hammer and fixed with the lime mortar.

The proportion of the lime mortar: 1 share of lime, 1 share of quartz sand, 1 share of black sand (thick fraction), 1 share of pozzolana.



Fig. Sizing



Fig. The stone cutting



Fig. Fixing



Fig. Fixing the stone



Fig. Fixing with the lime mortar

- Fixation of new stone details on existing cornice:

Adjusted new stone details, were fixed to the existing cornice and stainless steel belt frame by the fork type anchors. For these procedure the anchoring holes with diameter 6mm and 10 mm were prepared and cleaned by air jet and acetone mixture. Fork type anchors were produced from stainless steel stem of 4mm and 8mm diameter. The anchoring had been conducted with the use of two-component glue (epoxide).



Fig. Cleaning anchoring holes



Fig. Anchored stone details



Fig. Anchoring

- **Preparation of Cornice's stones surfaces for further reconstruction with a mortar:**

The reconstruction of the relatively less damaged cornice stones was done by lime mortar with following composition: 1 share lime, 1 share quartz sand, 0,5 share marble powder, 0,5 share black sand, 1 share pozzolana, 0,5 share white stone peddles of middle fraction and fibrous material. In some cases, to gain higher durability, the stainless steel frames had been arranged inside the plaster. The notches had been cut on the existing stones in the segments where increase of the grip force of lime mortar was needed.



Fig. Treated stone surface



Fig. The working process



Fig. The cornice stone before the reconstruction



Fig. After the reconstruction



Fig. The working process



Fig. The cornice detail after the reconstruction

Injection

At the final stage, joints between the stones were injected. The injection mixture proportion was: 1 share pozzolana, 2 shares natural hydraulic lime *NHL5*.



Fig. Injection

Stefano Volta

Methodology report about the conservation of building stones of the Early 12th-Century Church of the Virgin at Gelati Monastery in Kutaisi,