

STUDY OF DAMAGE QUALITY OF TAO-KLARJETI TEMPLES

Maya Chanturia, Giorgi Mamardashvili

*Georgian Technical University, Tbilisi 0170, Georgia
m.chanturia@gtu.ge*

Abstract

Tao-Klarjeti area is rich in monuments of Georgian architecture. This area has been under Turkish jurisdiction for centuries and our temples are neglected and neglected. The passage of time, earthquakes, various atmospheric events or human vandalism have greatly damaged them. The aim of the paper is to propose the arrangement of the designed seismic damping structural system in a temple for which it will be more effective.

Key words: earthquake, dome, temple, recovery-restoration.

Orthodox Christian churches, are a symbol of our nation's identity and spiritual strength. Cultural heritage is a nation's window into the historical past. That's why it needs to be treated and protected. It is known that Georgia is located in a seismically active zone, which is why earthquakes are frequent here. This natural event for centuries damaged our church monasteries, the restoration and strengthening of which was and is very important both for our ancestors and for our generation. Unlike ordinary buildings, during the restoration and deepening of cultural heritage monuments, we must take into account its constructive uniqueness. Its strengthening should be done with great clarity. Tao-Klarjeti is the richest in monuments of Georgian cultural architecture. The purpose of this paper is to visually examine the degree of destruction (damage) of the existing temples there. This study was conducted based on photographs from the Internet and various used literature, for which several

temples were selected. These are: Bana, Oshki, Ishkhani, Khandzta [1,2,3,4]. The restoration of architectural monuments was also ongoing during previous centuries. Since the middle of the last century, a specific scientific theory of the restoration of architectural monuments has been formed, which was founded at the first international congress of architecture and technical specialties in Athens, which was held in 1931, where the "Restoration-Restoration Charter" of the Italians, based on G. by Giovannini, presented their views. In 1964, at the Second International Congress, issues were discussed about the need to determine the need for restoration of architectural monuments; The first attempt to perfect the theory of restoration was attributed to the French scientist Paul Leon, who formulated concrete methods of restoration of monuments (1938), based on N. Balanos' restoration of the architectural monuments of the Acropolis of Athens demonstrated that restoration could serve several purposes. Alonza Riegl (1903) of the Austrian Empire pointed out that there are different methods of restoration of architectural monuments, and that they should be used accordingly. The eminent Italian scientist Amborgio Annoni argued that one cannot use the same method during the restoration of different monuments. He claimed that the restoration of architectural monuments is an extremely difficult process, it is specific, sometimes even the restorers themselves have a hard time imagining the goal and task of restoration.

Discussion

Bana Cathedral is an original and unique monument of Georgian architecture. It is a

central domed temple, which was surrounded, the remains of which are still preserved today. After Tao-Klarjeti became a part of the Ottoman

Empire, Georgian Christian churches found themselves in a deplorable state. During the Russo-Turkish war in the 19th century, the Turks used the temple as a fortress, which made it a terrible target for Russia. This further damaged this magnificent temple. It can be seen from the pictures that the dome of the temple has collapsed, there is no longer a dome neck. The railings on the walls are cracked. None of the 8 columns that supported the dome have survived, the wall on one side has completely collapsed. In terms of restoration and strengthening, the situation here is very difficult. My dissertation cannot deal with these difficulties. Here, perhaps, the conservation method will be more useful than restoration.

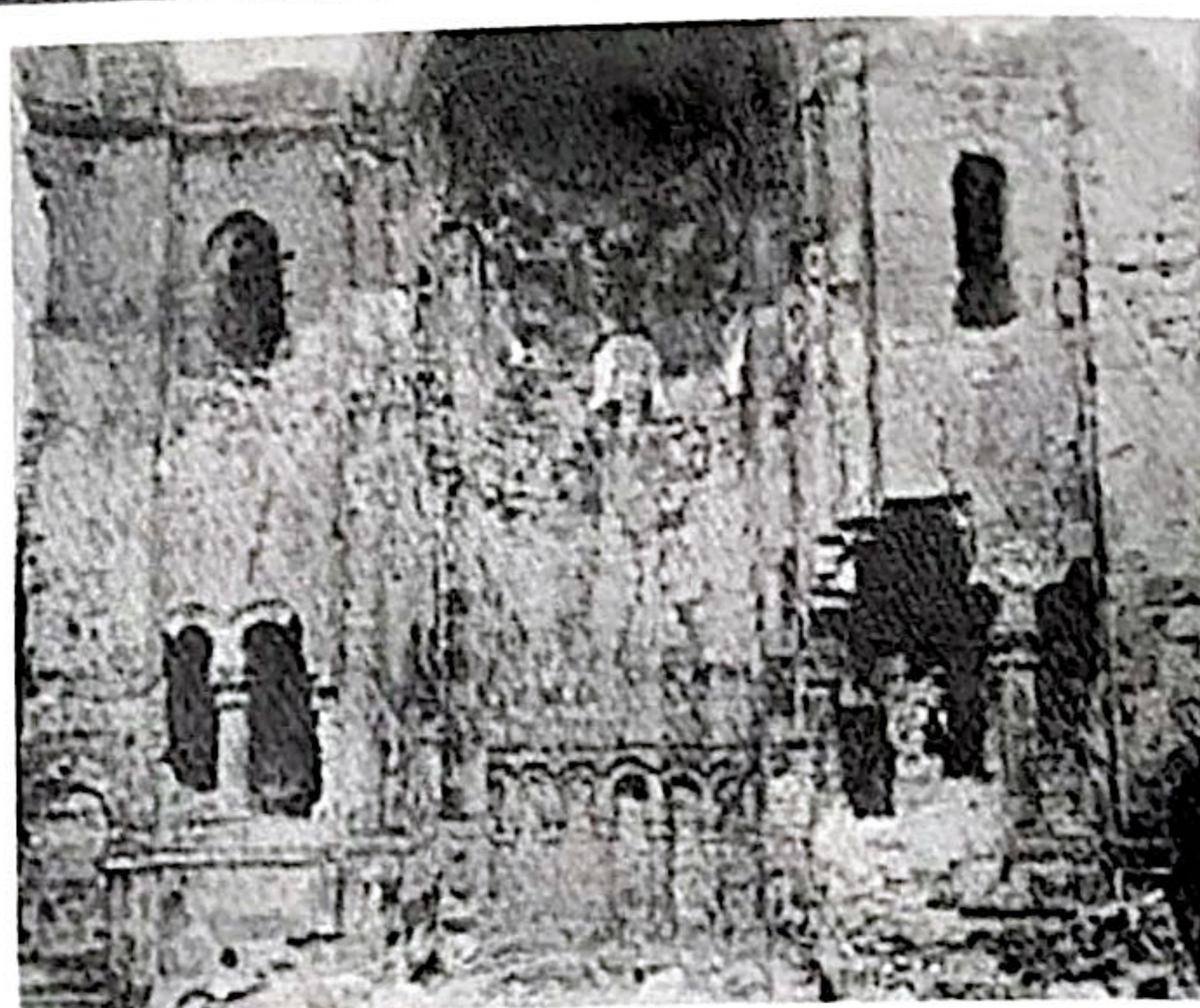
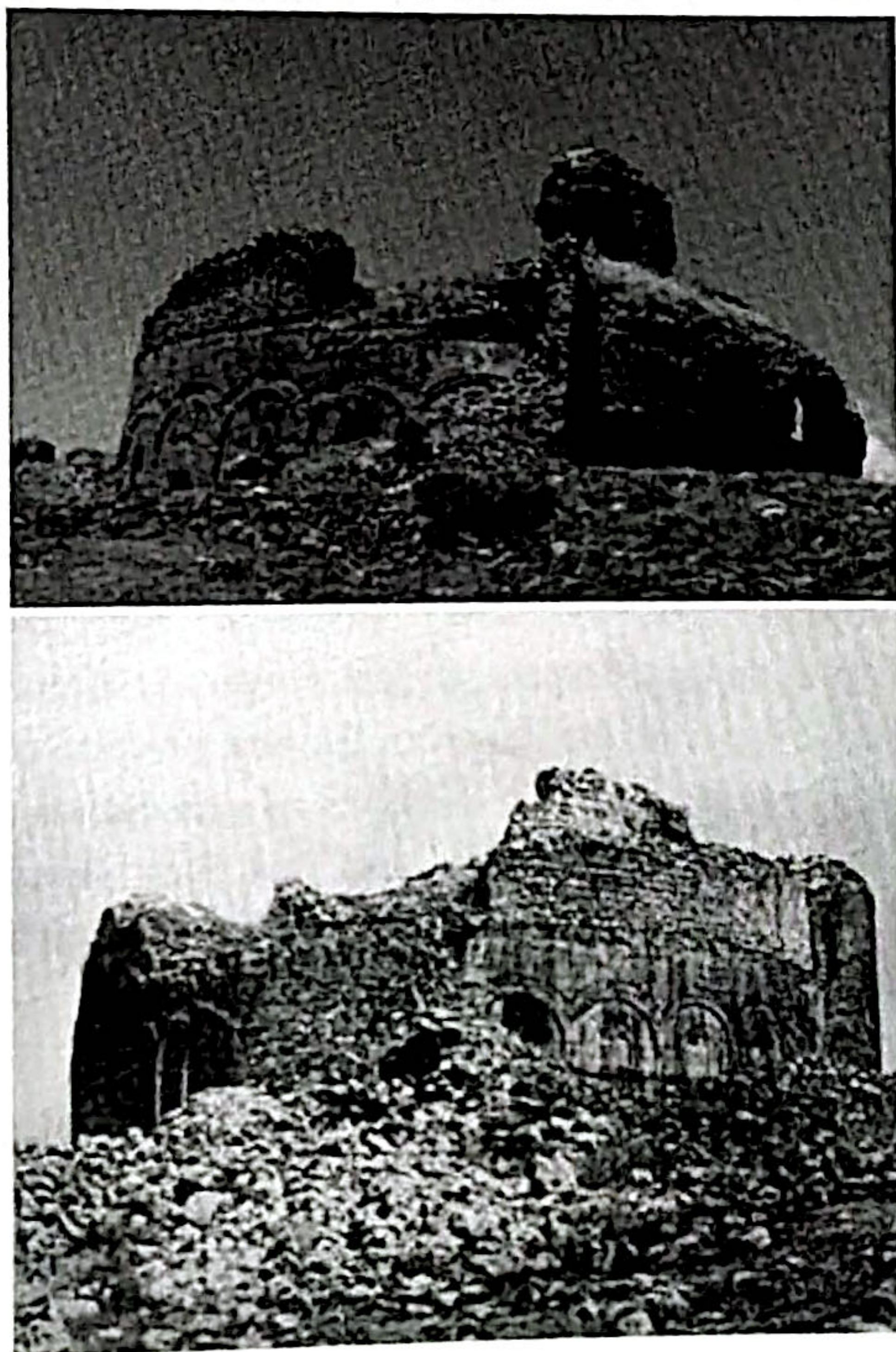


Fig. 1. Bana

Oshki represented the Episcopal Church; It is a cross-domed temple with a free dome. For a long time, the existence of Oshki was shrouded in fog for Georgians; Only in 1902, when Ekvtime Takaishvili traveled to Tao-Klarjeti for the first time and accurately described the state of the monument, its existence became known. Oshki is currently in a deplorable state; If its restoration-strengthening is not done in time, it may collapse (Fig. 2.); Especially since this shoulder is in the zone of high seismic activity. The main load-bearing structures of the temple, including the dome, still exist, although they appear to be quite damaged. As can be seen from the pictures, the dome's neck has not yet lost its stability, although the arched roof of the western arm has completely collapsed (Fig. 2). With the intervention of the World Organization for the Protection of Monuments, an agreement was reached between the Tukul and Georgian sides regarding the restoration of Oshki by the Georgian side. The seismic damping system developed by us can be used in the restoration of this temple.[5]

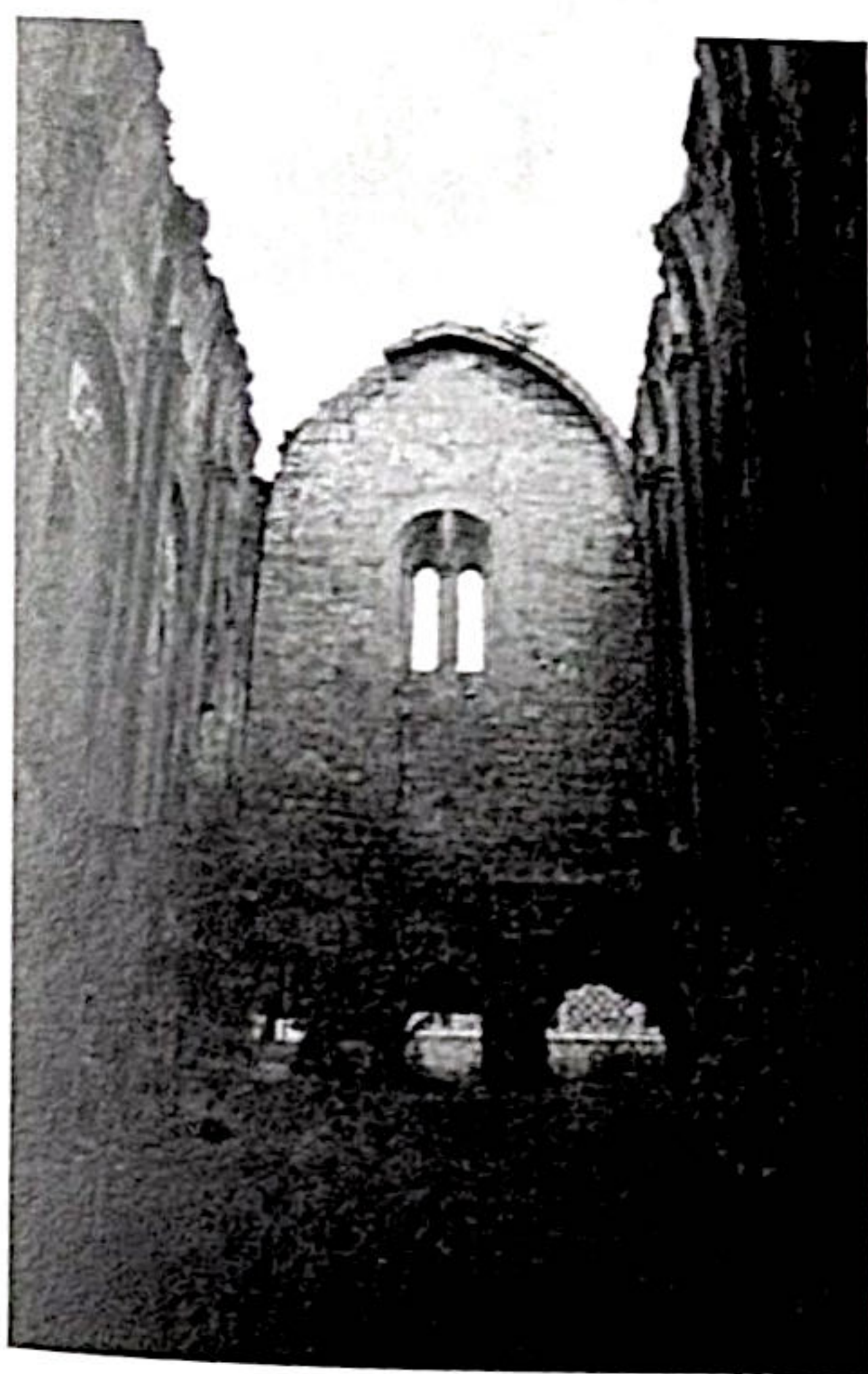
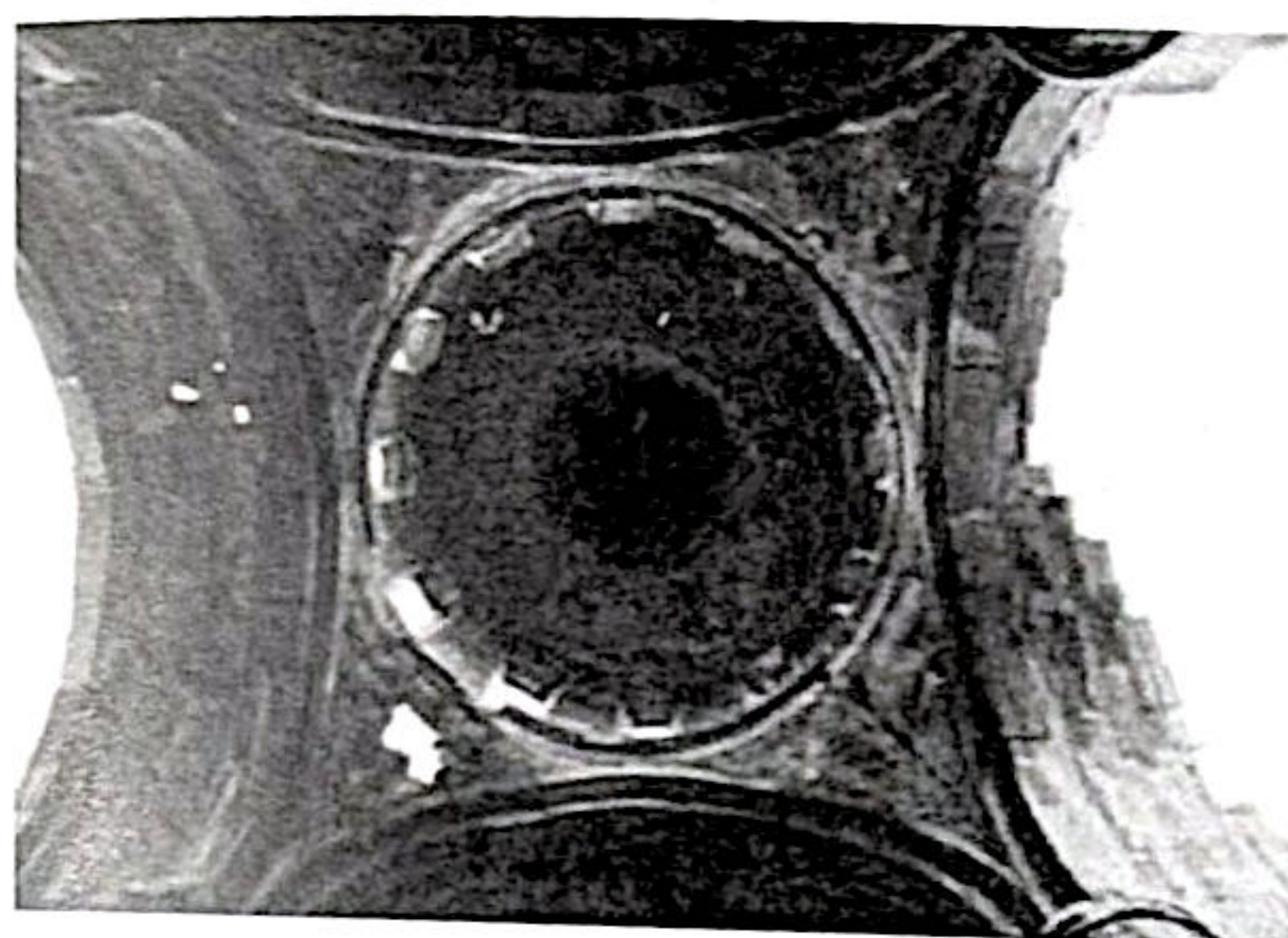


Fig. 2. Oshki - facade, dome, western arm

Ishkhan - the temple built by Grigol Khandzteli and his disciples, namely Saba Ishkhaneli. Outwardly, it seems to be the best preserved, however, after a detailed inspection, we will discover the damages that are numerous in the

temple and which, like other temples, require immediate help. The temple is an elongated cross-domed building (Fig. 3). The dome is badly damaged, with a fairly wide crack running radially from the cleat to the support ring. The throat of the dome is also damaged; The arched (vaulted) roof of the elongated western arm has been completely collapsed. It is subject to restoration-strengthening.



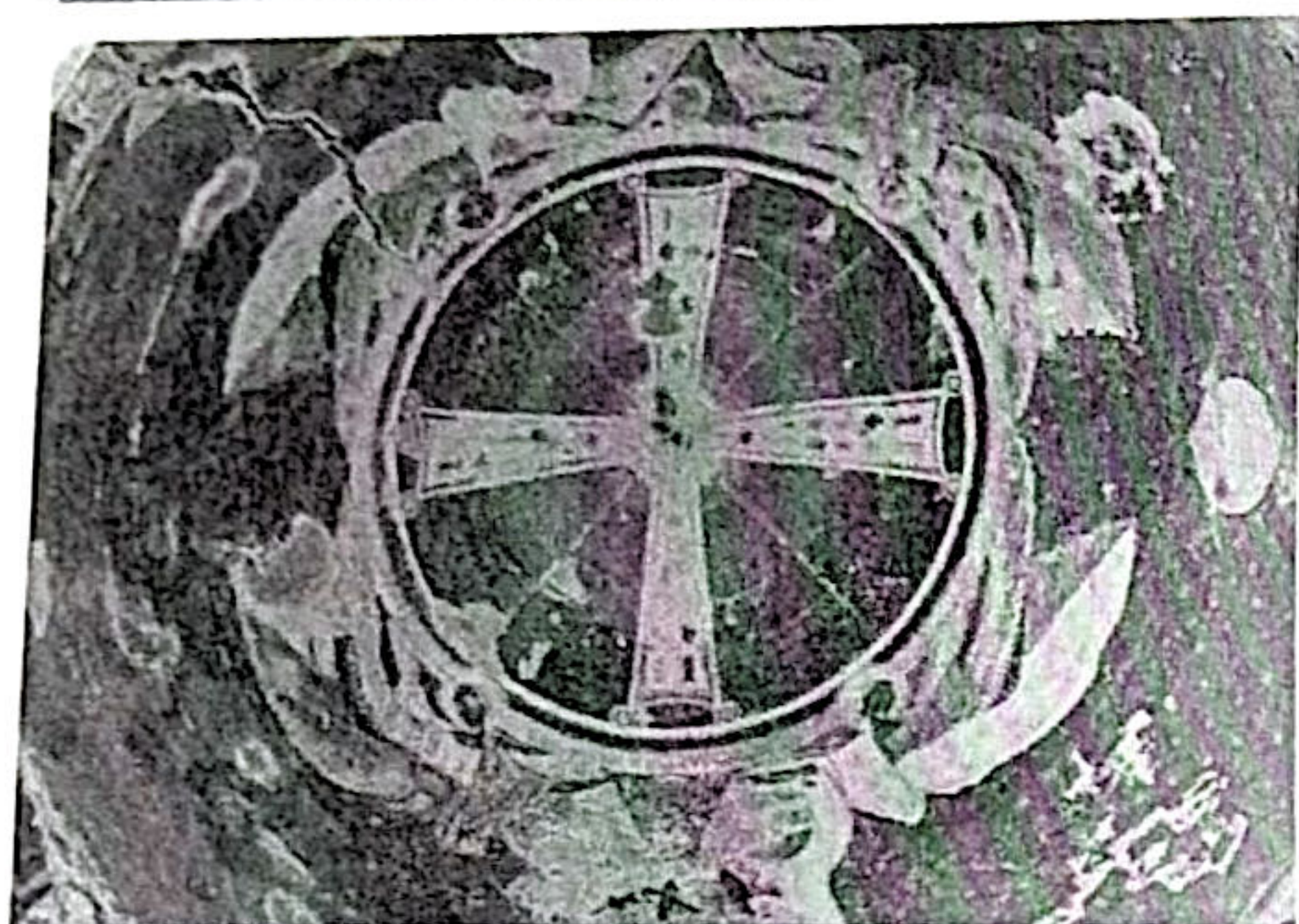
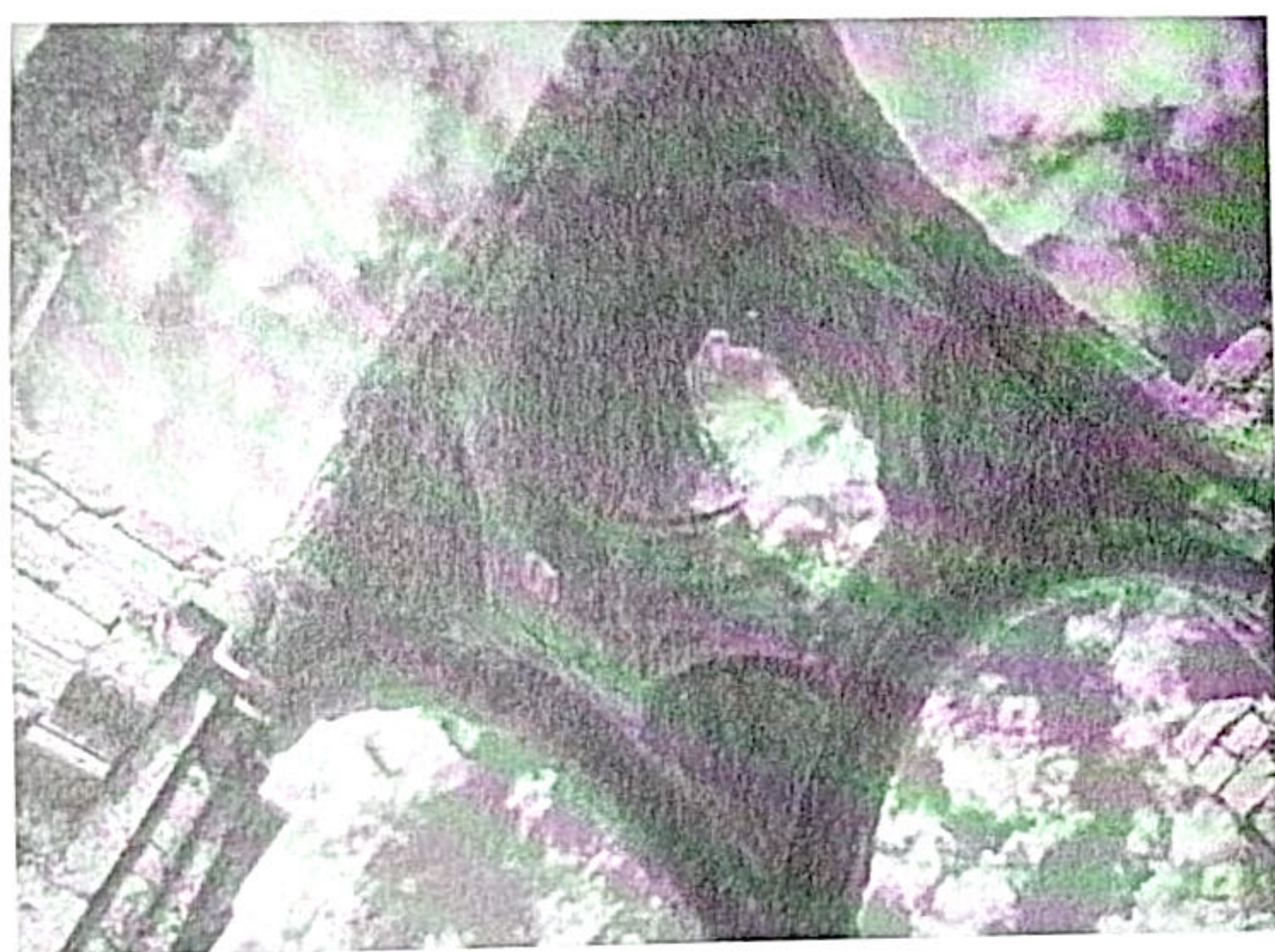


Fig. 3. Ishkhan - the throat of the dome, the altar, the dome from below



Fig. 4. Khandza

Khandza - the main temple is in the shape of an inscribed cross - it is a cross-domed temple (Fig. 4). Its dome rested on the walls of the apse on the east side, and on two piers on the west side, the remains of which have only survived. The pictures taken before 2007 show that the dome still existed (Fig. 4), and in 2010 - the dome has collapsed (Fig. 4). However, the neck of the dome is visible, on which, in case of restoration of the temple, it is possible to arrange a new dome. In this case too, it is possible to use the seismic suppression system developed by me.



As the above studies show, the main reason for the damage of our historical monuments in Tao-Klarjeti, along with the passage of time, is strong earthquakes. This event for centuries damaged our churches-monasteries, the restoration and strengthening of which was and is of the utmost importance both for our ancestors and for our generation.

Unlike ordinary buildings, during the restoration and deepening of cultural heritage monuments, we must take into account its constructive uniqueness. Its strengthening should be done with great clarity. The purpose of this work is to use seismic protection measures in the restoration of domes of damaged temples. Our ancestors used anti-seismic measures during the construction of temples from time immemorial. An example of this is the "swallow tail", or the use of stone blocks in dry stacking. They arranged the frames mainly at the neck of the dome or shell, where one structural part ends and the other - the dome or shell - begins, because there is a change in stiffness. It is this place that is dangerous during seismic impacts. The goal of our work is to restore the damaged dome of the temple and to equip it with seismic protection measures so that its authenticity is not violated. For this purpose, a computer calculation model was created, the spatial calculation of which was performed using the finite element method using the computing

complex "LIRA SAPR-2016". In general, the purpose of a seismic protection system is to reduce the seismic acceleration transmitted from the ground to the building. In our case, the cross-domed temple is structurally divided into two parts - the under-dome (cross) part and the dome itself. The function of the dampers placed between them is to reduce the seismic acceleration transmitted to the part of the dome.[5].

The constructional solution of seismic damping systems is as follows: a reinforced concrete grooved belt is arranged on the support ring, which is also the binder of the arches. Metal sheets will be anchored in the groove, on which the damper is mounted: rubber-metal (widely used in viaducts and overpasses in the places of support of the Mali structure) and spring. The throat of the dome is connected to the damper by a valve. Holes are made in the throat of the dome (shown in the diagram below), in which metal anchors are placed to limit vertical movement. As far as is known, this type of construction has not yet been used in practice, so it is a novelty.

Rubber-metal dampers of the new seismic suppression system were used for seismic isolation. The Seismic Isolating Rubber Bearing consists of alternating laminations of thin rubber layers and steel plates (shims), bonded together to provide vertical rigidity and horizontal flexibility.

Vertical rigidity assures the isolator will support the weight of the structure, while horizontal flexibility converts destructive horizontal shaking into gentle movement.

Rubber-metal dampers, as well as spring-type dampers, may be arranged in the structure arranged in the throat of the dome of the temples under construction. Based on their positive and negative characteristics, as well as the calculation, it should be decided which of these

types of dampers we will choose for temples (Fig. 5).

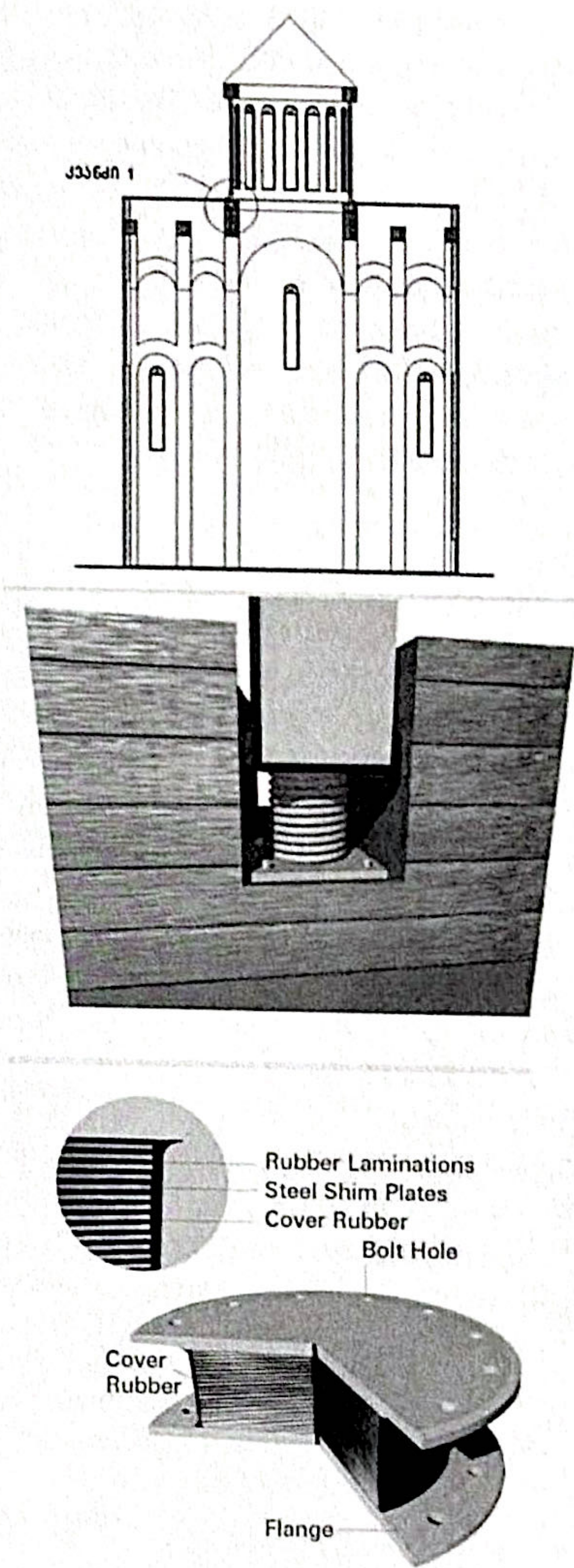


Fig. 5. temple slit; Seismic Isolating Rubber

Conclusion

As the analysis of the results of strong earthquakes shows, the contact zone between the under-domed part of the temple and the dome is the most damaged and often becomes the cause of the collapse of the dome. Tensile stresses caused by seismic impact in this zone are several times higher than the calculated tensile resistance of the stone (brick) pile. Therefore, it is possible to specify the purpose of our proposed dampers - to reduce as much as possible the value of seismic bending moments in the mentioned contact zone, which will minimize the value of tensile stresses.

References

1. Beridze Vakhtang, "Ancient Georgian Architecture" - volume, 1974; (Georgia)
2. Khoshtaria D., "Churches and monasteries of Klarjeti", Tbilisi, 2005 (Georgia)
3. Khmelidze T., Kifiani G., Khmelidze K., Vanishvili, "Monuments of Georgian Architecture". "Universal" publishing house, Tbilisi 2018, 202 p. (Georgia)
4. Silogava V., «Oshki X century. Memorial Temple", Vol. 2006, ISBN 99940-890-6-4; (Georgia)
5. Mamardashvili G., Lebanidze A., "Anti-seismic measures in Georgian architectural monuments", 2nd international symposium "Seismic resistance and engineering seismology", collection of reports. p. 161-163. (Georgia)