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ASPECTS CONCERNING THE RESTORATION OF THE HISTORICAL MONUMENT "ST. NICHOLAS CHURCH" (1594) IN ARONEANU, IAȘI, ROMANIA

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Abstract

Church "Sf. Nicolae", located in Aroneanu, a village near Iași - Romania, belonging to a former Orthodox monastery founded in 1594 by ruler Aron Vodă, was the subject of an extensive consolidation and restoration project, and in 2015 it was included on the List of Historical Monuments of Iași county, having the classification code IS-II-m-A-04098. The complex restoration process required a series of preliminary studies and tests to identify structural problems and degradations of the decorative elements. After establishing some safety parameters for the preservation of the historical ecclesiastical monument, the actual works began, starting with the consolidation of the structure and culminating with the restoration of the exterior decorative elements. All the interventions carried out on the historical monument led to a harmonious and unitary result, as close as possible to the original historical image the church had, during Aron Vodă's reign.

Keywords: monument, church, ecclesiastical, degradation, restoration, structure, decorative element, seismic isolator

1. Introduction

The Church of "Sf. Nicolae" in the village of Aroneanu - Iași has been an ecclesiastical settlement since the time of ruler Alexandru Lăpușneanu. The monastery founded by the fierce ruler of Moldavia was originally positioned downward from the current location, this being recorded in the magazine 'Mitropolia Moldovei și Sucevei' from 1967, the Aroneanu Church: "was built by Alexandru Voivod (Lăpuşneanu) on another place under the hills and it scattered and fell completely" [1].

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In the period 1591-1595 Aron Vodă nicknamed 'the terrible' becomes the ruler of Moldavia. He inherits from his father, Alexandru Lăpușneanu, the cruelty and cold blood with which he fought riots. In order to atone for his sins and injustices towards the people and God, he contributes to the decoration of the Church "St. Nicolae" in Brașov and founds the Aroneanu Monastery. The chronicler Grigore Ureche recorded that ruler Aron Vodă "... first thought that, after so many bad things that he had done, he should get to do something good, so that he would not be condemned. And they started in the year 7102 (1594), to make a monastery in the county of Iasi, that will be called Aron Vodă, after the lord's name, where St. Nicholas is the patron saint" [2].

After the reign of Aron Vodă, Ieremia Movilă issued a decree entrusting the Aroneanu Monastery to the monks of the Zografu Monastery from Mount Athos. The decree mentions the original founder, Alexandru Lăpușneanu, Aron Vodă only contributing to the consolidation, using the materials painstakingly gathered by Petru Șchiopul [3]. The document was contested by Aron Vodă's widow, and ruler Radu Mihnea revokes it, re-establishing the home of local monks. In his second reign, he reverts on the decision, assigning the Aroneanu Monastery to the Podrom Monastery in Sozopol.

After countless changes regarding the entrusting of the settlement to the Greek monks, in 1734 it was recorded that Aroneanu Monastery was 'befallen' and at "great lack and weakness, from the hardships of the times that came upon this land". The surrounding walls having been destroyed, it was decided to enclose it with a fence, and "all that's broken and desolate" to be cleared. However, a little later, it is shown that the monastery was "unkempt in many places, fallen down, with the tower uncovered, without a fence, the houses old and more and more uncovered" [1].

In 1863, out of fear of the secularization of monastery assets during the reign of Alexandru Ioan Cuza, the monastery relinquished its lands and hegumeny to an individual from Constantinople, a fact facilitated through Russian diplomacy [4].

Three years later, the Catargiu Government restored and reinforced the monastery's church. Only the place of worship from the original ensemble was preserved, with it becoming a parish church in 1868.

In 1906, the surrounding wall and the bell tower were dismantled, with the bricks being used in the villagers households and for closing the church's porch. "Alone, the church appears with no other change than the later plastering, which peels off and falls currently, than the cheap and hurried roof, than the closing with rubble bricks of the empty space between the porch pillars." In the immediate aftermath, N. Ghica demolished the makeshift closure of the porch, but at the villagers request, it was rebuilt with quality materials, ensuring easy identification of the original form. From images taken before the repairs, a steel band ring around the base of the tower's windows can be distinguished, a detail that becomes more evident after the restoration works of 1907.

Following the earthquake of 1940, a series of cracks were identified on the church's spire. The structure was reinforced with bars and metal plates. Towards the end of the decade, after the church underwent extensive consolidation, the

Metropolitan Cathedral donated the iconostasis from St. George (the old Metropolitan Cathedral) to the church, which initially belonged to St. Nicholas Domnesc Church in Iași.

In 1966, following a severe storm, the church suffered significant damage to the nave's roof structure. Works were initiated to replace the degraded roof structure, except for the tower and the star-shaped base, for which the roofing was partially replaced.

During the communist regime, the Church in Aroneanu was neglected, visibly deteriorating. The church exhibited obvious structural cracks, the plaster was in an advanced state of degradation, and the roof had sealing problems, with visible signs of prolonged infiltration.

2. Initial situation

The Church of Aroneanu, a class A historical monument of national interest, was built in 1594 by Aron Vodă, on the site of an older monastery founded by Alexandru Lăpuşneanu.

From a geomorphological perspective, the Church of Aroneanu is located within the Moldavian Plain region, specifically in the Lower Jijia Plain subregion, within the Bahlui Corridor unit, in the Aroneanu Upper Terrace subunit.

Geologically, the formations encountered in the area belong to the Sarmatian and Quaternary periods. The Sarmatian represents the foundation of the area and is characterized by a violet-gray marly clay found at depths usually exceeding 20.00 meters.

The Quaternary layer covers the Sarmatian and is represented on the surface by a layer of fillings ranging from 0.60 to 0.90 meters in thickness, composed of a clay-loam loessoid complex, with a thickness of 6.00 meters, followed by a sandy loam horizon, 5.00 meters thick, beneath which lies a clay layer 5.00 meters thick, followed by a saturated granular layer.

Based on the above, the terrain on which the building stands has an increased potential for slope landslides and flash floods from torrents.

From a seismic perspective, areas outside the Carpathian arc, to the south and east of the Vrancea epicentre, Romania, are directly exposed to significant seismic movements. Thus, according to studies conducted in the intervention area, the ground acceleration coefficient is 0.20 g. Regarding the corner period, which represents the boundary between the zone of maximum values in the relative velocity spectrum, in Aroneanu, it reaches a value of 0.70 seconds.

Therefore, at the European level, the Moldavian region falls into a category of increased seismic risk, requiring additional measures for the seismic design and consolidation of buildings with historical and aesthetic value. Based on these data, a combination of factors is identified that could rapidly degrade and even endanger valuable local and national built heritage. For long-term consolidation, state-of-the-art technological approaches are necessary to minimize the effects of imminent natural disasters.

2.1. Architecture

From an architectural point of view, the construction of the church respects the classic plan of churches from that period, having the nave in the shape of a cross resulting from the external development, on the sides, of the apses of the nave and, to the east, of the apse of the altar. To the west, the nave is extended with a porch originating from the Muntenia region. Above the nave rises the spire of the church, placed on a star-shaped base which, in turn, rests on a square-shaped base.

Figure 1. Aroneanu Church after restoration

Inside, the characteristic functions of Orthodox places of worship are clearly defined by specific architectural boundaries. Thus, moving from west to east, the following spaces are differentiated: the porch, the narthex, the nave, and the sanctuary. The sanctuary, with a semi-cylindrical shape covered by a semi-dome, is oriented towards the east, a characteristic feature of Orthodox places of worship. This space is dimly lit by a single window along the church's axis of symmetry. The nave, the dominant space of the church, is inscribed in a square, with the southern and northern sides complemented by semi-circular apses smaller in size than the sanctuary. The nave is centred on the church's vertical axis, traditionally serving as the birthplace of the spire. The reduction of the spire's drum diameter is achieved through the technique of staggered arches, a characteristic feature of the Moldavian region. Additionally, the spire is well-lit by 12 tall windows flanked on the interior by a series of prominent ribs. In contrast to the spire, the nave is illuminated only through 2 windows located on the lateral apses. The separation between the nave and the narthex is structurally achieved through two massive columns, a feature also found in the Church of Saint Nicholas Domnesc in Iași [5]. Also inscribed in a square, the narthex terminates at the top with a flattened dome, directly born from pendentives. The initially open porch, typical of the Muntenia region, was walled at the request of the parishioners, who

cited the reason of harsher winters compared to those in the southern part of the country.

The church (Figure 1) is one of the first ecclesiastical spaces in Moldova with elements originating from the Muntenia region. This paternal transfer is due to the fact that the rulers bought their throne, not always being natives of the respective country. The trend of importing elements from Muntenia was also reflected under the reign of Aron Vodă, even if he came from a Moldovan family.

The open porch and the median girdle are the main elements from the Muntenia region in the church's architecture. Also, the opening between the pronaos and naos constitutes another specific mountain element, forming a single body, being separated by a colonnade. From a chronological point of view, the Aroneanu church is the third church in Moldavia with this characteristic, after the Hlincea monastery (1574) and the Galata monastery, Iași, Romania (1584).

2.2. Initial structure

The structure of the church is made of brick walls, 1.20 m thick. At the base, the walls are placed on a plinth, approximately the same thickness, made out of shaped stone blocks, of different sizes, built with a lime mortar binder.

The foundations are made of unhewn stone, harder stone at the base (sandstone), about 30 cm and weaker in the rest (limestone), built with lime mortar binder. The edge of the foundations varies by 20...30 cm the edge of the plinth, exceeding this dimension, in the area of the apses, by up to 40 cm. The foundations have a height of about 1.60 m and descend below the ground level by 1.90...2.15 m. Inside the foundation walls, around the area of the apses, there were discovered channels that were left after some wooden tie rods inserted in the masonry rotted.

The constructive composition of the porch is a novelty from a structural point of view, because, for the third time in Moldova, its structure is designed as a structure on pillars and not as a structure with walls in which there are openings for doors or windows (the first porch, of this kind, was realized at the Hlincea monastery, then at the Galata monastery, both showing influences from Muntenia).

All arches, domes and pendants are also made of bricks with dimensions of (13.5...14)×28×5 cm. Inside the domes, the bricks were placed obliquely to the direction of the beam, resulting in a section of about 20 cm. The dome over the pronaos has a variable section, being stronger at the bottom. At the base of the tower were found channels left after the wooden ties rotted, placed in a polygonal shape and embedded in the masonry.

At the time of the intervention, cracks were revealed near the nave windows, on the outside, due to the repeated seismic action suffered by the construction and the uneven settlement of the foundation land [5]. Following the performance of the technical expertise, a series of significant structural degradations were noticed that put the historical monument at risk. Thus, at the level of the nave, cracks were identified in the area of the gaps of the facades, cracks in the apse of the altar and cracks at the cornice, at the tower, diagonal cracks towards the corners of the windows and dislocated and rotated masonry at

the base (Figures 2-3), and at the level of the frame, collapsed, rotten structural beams and leaky casing.

Also, inside, the existence of cracks in the arches between the columns, at the birth of the side arches, degradation in the stone lintel, respectively cracks in the keys of the windows in the apse, were found.

According to the technical expertise, the insurance degree of the nave resulted with the values R = 0.28 in the section from the zero level and R = 0.34 in the section at the base of the windows, about half of the minimum value allowed (Rmin = 0.6). Under these conditions, measures were imposed to strengthen the walls of the nave and the foundations.

Figure 2. Structural degradation

Figure 3. Structural degradation

2.2. Finishes

The finishes of the historical ecclesiastical monument in the village of Aroneanu are unique for the era and the area in which it was built, being inspired by the richly decorated churches in Muntenia. Thus, on the outside we find the median bay that surrounds the church and divides it into two registers; The register at the top consists of two rows of decorations: one contains green and yellow ceramic elements in the form of a disk and a 6-pointed star shape, and the other of ceramic elements having a spindle pattern [6]. In the upper register, the drawings have a rhythmicity taken over by the lower register, the green ceramic elements specific for this place of worship being predominant.

Also, both the general framework and the roof of the spire, in particular, are configured according to the masonry structure over which it rises. In the wet plaster, drawings were executed by folk craftsmen, imitating scribbled models in a clumsy way, however, this is precisely what gives these decorative elements a special charm (Figures 4-5).

Inside, the floor of the porch is made of mosaic, and the rest is finished with wooden floors, being raised by one step at the pews from the north and south and by two steps at the altar. The original fresco of the edifice was completely lost following a fire, and until the moment of restoration, no further intervention was made, the church being devoid of interior murals or applied decorations.

The roof of the nave is in the form of a wooden frame that follows the shape of the nave, the crest above the altar being lower. The tower has a bell-type roof specific to the Byzantine style from Muntenia. Both the wooden structure of the frame and the sheet metal casing required major interventions, as they were in an advanced stage of degradation caused by water infiltrations.

Figure 4. Facade degradation

Figure 5. Socle degradation

3. Operations

The data collected from field studies have highlighted the necessity for significant intervention on the monument in order to restore its former aesthetic value and stabilize it against unpredictable natural hazards. Interventions on the historical monument began upon completion of preliminary studies that established the resilience capacity of the monument undergoing consolidation works. The works were phased, based on fund accessibility and the severity of the existing monument situation. Thus, from 2001 to 2004, interventions focused on the tower and the church's roof structure, while starting from 2015, the restoration process was completed, reaching its climax: the installation of the building on 48 seismic isolators.

3.1. Architecture

As for the architectural interventions, they were minimal, with the main aim of restoring the original image of the church from the end of the 16th century. Thus, the visible interventions were carried out at the level of the framework, by replacing the old covering with a copper one, keeping however, the original volumetric configuration. The windows on the tower facades have been reinstalled or brought back to their original dimensions where it was possible.

After the restoration process, necessary constructions were added for the services of the religious community, such as: a bell tower, a gazebo-type pavilion, respectively a multifunctional social annex. All these elements were designed in such a way as to visually impact the whole monument as little as possible and to keep the church as a historical monument at the centre of gravity of the composition.

3.2. Structure

In the period 2001-2004, works were carried out to strengthen the spire and the nave, at the level of the roof, which consisted in strengthening the spire by providing 12 reinforced concrete pillars at the edges; on the upper part, the pillars were strengthened with a reinforced concrete belt placed on the crown of the wall; at the base, the pillars were embedded in a belt embedded in the masonry of the stellate base of the tower.

It was also ordered to restore the wooden dome in the form of a brick masonry dome, with a belt at the base, connected by the pillars from the edges of the spire. Later, the star base was strengthened with 6 reinforced concrete pillars, embedded in the masonry. At the upper part the pillars were connected by a belt on a star base and the lower part by a belt on a square base. Also, the consolidation of the square base was carried out with four pillars embedded in the masonry that make the connection between the beams at the base and the belt on the square base.

The execution of four reinforced concrete beams at the base of the tower that ensures the load transfer to the walls of the nave, the consolidation of the semi-dome of the altar with perimeter belts and the creation of a perimeter belt at the level of the cornice of the nave represented vital stages in the consolidation of the historical monument.

The consolidation intervention required a structural system of reinforced concrete frames that have a double role: to stiffen the existing structure of brick masonry and to transfer the loads to the foundation. This structural skeleton, made up of belts and pillars, follows anatomically/organically the architectural forms ensuring a small impact on the historical substance of the monument.

In 2015, the procedures for the continuation of the consolidation works were resumed, starting with the casting of the upper, inner and outer belts. These belts are executed during the first stage to support and secure the walls of the church during the execution of the foundation beams, which involves breaking the foundation, strengthening of the foundations by internal and external slips, with belts having a section of 50x60 cm, placed about 30 cm below the level of the pavement.

The belts were tied with reinforced concrete braces passed through holes drilled in the foundation masonry, the holes being executed by core drilling. At the top, the belts on the two sides of the elevation connect with bolts (Figures 6-7). The purpose of braces and bolts is to ensure the binding of the lime mortar with the stonework, with which the foundation was made; bolts were inserted into cored holes.

The novel element regarding the intervention on the historical ecclesiastical monument is the introduction of seismic isolators under the foundations of the building. After making the foundation belts, the monument is suspended by means of hydraulic jacks (Figure 8), to make it possible to insert the jacks between the foundation of the church and the foundation anchored in the ground.

Typically, seismic isolation systems are applied in constructions housing equipment sensitive to earthquakes [7]. However, in Romania, it is the first time

such technology is being implemented on a heritage building. In the areas where the seismic isolators were installed, metal plates embedded in concrete are positioned (at the soffit of the beams and braces).

When designing the foundation beams, the uniform transfer of pressures on the ground and a sufficient rigidity to allow the operation of the pendulum-type seismic isolators (Figure 9) were ensured (the allowed arrows must be below 5mm, from one end of the foundation to the other).

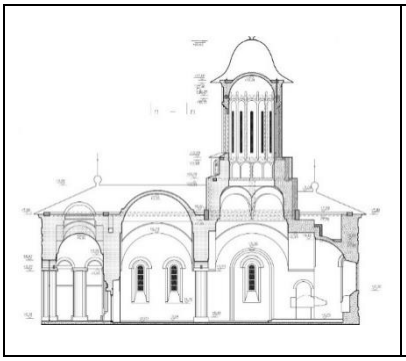

Figure 6. Section plan

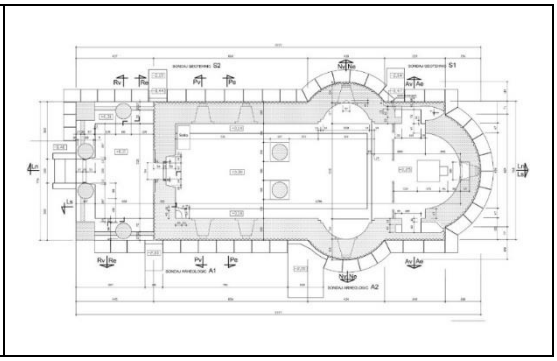

Figure. 7 Floor plan

Figure 8. Hydraulic jack

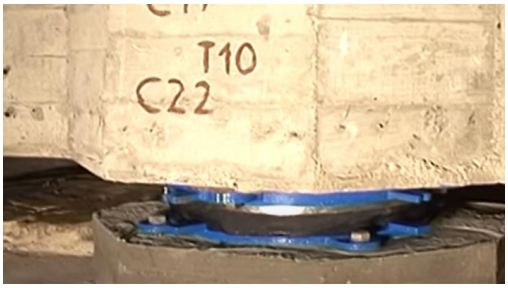

Figure 9. Seismic isolators

The foundation beams were executed with a section of 70×50 cm, at the foundation level of the existing foundation, externally and internally; the beams are executed in three stages, starting from the porch towards the altar. Then, the beams were passed through the masonry, at the intersection of the walls and in their field. Reinforcement loops were left in the areas where the insulators were positioned, later embedded in the insulator pedestal (and cast after their installation).

The arrangement of the 48 insulators under the foundation beams is carried out individually, the insulators being fixed in the metal plates embedded in the soffit of the belts; a fast-hardening concrete bearing is poured under the insulators. Thus, the stress transfer from the existing foundation to the isolator is done by putting the consolidated foundation under tension, with hydraulic jacks, and after the concrete in the bearing has hardened, the tension is released, thus realizing the stress transfer from the jacks to the isolator.

The last 3 stages of the execution of the foundation structure were: cutting the foundation between the insulators (with core), installing all 48 pieces, making the external channel for inspection and ventilation, respectively making the inner floor (flooring).

3.3. Finishes

As for the finishes, the green and yellow ceramic elements specific to the religious edifice are kept on the outside and a layer of white paint is applied after cleaning the surface of the facades.

Inside, the plaster was stripped and redone in the form of lime plaster, as a support for the fresco.

The mobile heritage elements such as the original iconostasis from the Church of St. Nicolae Domnesc Iași, were restored in a separate project led by a team of accredited restorers.

4. Results

The long restoration process has the ultimate goal of returning the general image of the monument to its original state, as it was during the reign of Aron Vodă.

Currently, the church has reached an ideal stage for a nationally significant historical monument: its structural integrity has been consolidated and brought up to current stability standards, thereby protecting it from natural calamities that are difficult to anticipate or prevent. Following the interventions in the initial phase of the project, the roofing has been sealed, and the wooden structure has been reinforced. Additionally, at the tower level, a system has been implemented to prevent the masonry from loosening by pouring concrete belts.

Furthermore, by pouring the foundations preceding the seismic isolators, increased resistance has been achieved to enable the building to withstand vertical displacements for the installation of hydraulic devices. Moreover, through systems preventing the loosening of brick masonry, the historically significant structure has been transformed into a solid, resilient block capable of uniformly distributing external forces across all 48 shock-absorbing devices.

The most important element resulting from the consolidation and restoration operations consists in increasing the degree of stability to seismic movements through the implementation of the 48 seismic isolators.

The restoration of the original historic exterior appearance was achieved by applying a layer of white paint on cleaned plaster using traditional techniques, thus preserving the monument's original character. Additionally, the green and yellow ceramic elements were enhanced through cleaning, and where necessary, completions were carried out using historical techniques.

After the completion of the consolidation and restoration works, the interior of the church was decorated with frescoes, and a series of landscaping works was carried out on the exterior to highlight even more the central element of the composition. The ensemble made up of the church, pavilion, bell tower, social

annex and enclosure wall give a unified image, in which the present and the past blend harmoniously.

Conclusions

The Church of the former Aroneanu Monastery serves as an exemplary paradigm for the restoration and consolidation of historical monuments, representing a model worthy of emulation for future restoration projects. This church is emblematic not only for its beauty and historical value but also for the implementation of cutting-edge technologies in its conservation process. A particularly notable aspect is the introduction of seismic isolators in the consolidation and restoration project, marking the first use of such an anti-seismic system on a historical monument in Romania.

By employing these advanced technologies, a commitment and responsibility towards the protection and preservation of the country's cultural heritage are demonstrated, regardless of the costs and efforts involved in their implementation. It is crucial to resort to the most modern and efficient methods to conserve a monument of such artistic and historical significance, aiming to ensure its longevity for future generations.

The Church of Aroneanu remains a monument that continues to inspire and bear witness to the past and cultural identity of a community, representing a stable pillar of local history and traditions.

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