

Review

# Seismic Rehabilitation Techniques for Conserving and Managing Cultural Heritage of old City Fortress in Novi Pazar

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**Abstract:** In the last decade, increased awareness of the importance of preserving old masonry structures of cultural heritage has turned to the development of sustainable strategies for their reconstruction and seismic strengthening. This research includes the analysis and determination of the necessary measures due to the assessment of the condition of the constructive and structural parts of the buildings belonging to the old City Fortress in Novi Pazar. In this study, the fragility and vulnerability of the building is identified in order to sanction and recommend strengthening and seismic resistance to potentially strong levels of earthquakes, preserving the original structure of the building and its authenticity and integrity. The presented techniques aim to improve seismic performance and preserve structures for future generations, with the least impact on changing the value of the investigated cultural heritage. On the other hand, due to the modern demands of society, it is recommended to implement digital conservation and management of cultural heritage in order to create new content and ensure accessibility for all.

**Keywords:** masonry buildings; authenticity; improvement; seismic strengthening; historic urban space; sustainable management



**Citation:** Aleksić, J.; Zećirović, L.; Dragović, D.; Slavković, B.; Suljević, J.; Božović, J. Seismic Rehabilitation Techniques for Conserving and Managing Cultural Heritage of old City Fortress in Novi Pazar. *Appl. Sci.* **2022**, *12*, 12018. <https://doi.org/10.3390/app122312018>

Academic Editors: Guoshan Xu and Theodore E. Matikas

Received: 30 September 2022

Accepted: 16 November 2022

Published: 24 November 2022

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## 1. Introduction

“National traditional architecture is not a style, but a view of the world and of life, of nature and of the spirit of the place, an attitude towards life processes and materials, towards the climate and authenticity” [1].

In the territory of Novi Pazar, there are numerous historical monuments created during the time of the Turkish invaders. A sample of them includes the Altun-Alem Mosque, the Arab Mosque, the Old Turkish Spa (Hammam), the City Fortress, and many others. The preserved monuments in this territory represent authentic testimonies of the oldest original forms of artistic expression of the Serbian people and at the same time of the highest peak in architecture and painting (the famous Raska School of painting). Archaeological findings testify that this area has been continuously inhabited from the Stone Age—the Naprelje finding, through the Iron Age—the Smolucka Cave finding (with traces of settlement from prehistoric times), and the Early Christian Era—the Novi Pazar finding, as well as the remains of the late antique and medieval fortifications of Jelec and Ras.

The city of Novi Pazar was born at the crossroads of heritage, at the intersection of cultures. Its inhabitants, as the original guardians of the city's heritage, get to know the layered heritage of this cultural circle, with topics from ancient, medieval, Ottoman, and modern civilizations. This paper aims to indicate the rehabilitation techniques of complexes of cultural importance in case of earthquake activity. The old Fortress in Novi Pazar represents a smaller urban unit of great importance for preserving the memory and traditions of the population from this area.

The restoration of this historic building should be approached from a multidisciplinary perspective. It can be analyzed through two key aspects: identity, i.e., its historical significance, context, and social circumstances and the place of focus of collective memories, and on the other hand as a visual spatial reference point defined by the urbanity and landscape of the city of Novi Pazar. These two aspects are connected through constant modifications of space and different social and historical contexts. Modification is the only permanent feature of this space and should continue in order to preserve the space. [2] The city fortress developed and changed through the centuries and conquerors, forming an urban structure around which the settlement pattern arose—mainly during the Ottoman times, with its nucleus, Motrilja Tower. Novi Pazar has won the title of European destination of importance thanks to the monuments on the UNESCO list, as well as its characteristic history in which Christian and Islamic civilizations overlap and collide.

Novi Pazar was the first capital of medieval Serbia which, during the Ottoman Empire, became a prosperous town and a lifeline on an important trade route. Today it is a city with a relatively large number of inhabitants, imbued with oriental charm. The remains of the medieval architecture of this region are of enormous national, regional, and international importance. This paper presents a combination of traditional and modern methods that improve the seismic resistance of buildings in order to preserve the identity of the existing building. The mentioned techniques significantly improve the structural properties of the building with minimal interventions, which increases the stability of its walls and does not change the physical appearance of the building. Bearing in mind the importance of the City Fortress in Novi Pazar, as well as the fact that it has not been treated from this aspect in science so far, the topic of this paper is expected to make a certain scientific contribution. The research area was chosen due to the lack of data for the wider community about the value of UNESCO world cultural heritage buildings in Novi Pazar. Programs for the future participation of the local community in the processes of preserving and promoting the values of the city of Novi Pazar should be developed on the aforementioned basis [3].

The Law on Cultural Heritage (Official Gazette RS, No 129/2021) establishes emergency protection measures, special restrictions, deadlines, and necessary financial resources, in case the cultural heritage is damaged or exposed to immediate danger from natural disasters or causes of human origin.

Conservation, strengthening, and restoration of architectural heritage require a multidisciplinary approach. The International Council on Monuments and Sites, ICOMOS, was established for the purpose of organized action. Strengthening the fabric and structure of the building are the only means by which it is possible to reduce the effects of an earthquake [4]. Repair and reconstruction techniques must be properly selected in accordance with the structure and characteristics of the material. Historical buildings do not have their cultural significance exclusively as relics from the past, and the value of architectural heritage is not only in its appearance, but also in the integrity of all its components as a unique product of the specific construction technology of its time. Methods, approaches, and tools related to the minimization of seismic vulnerability and energy consumption are increasingly used and tested to ensure, at the same time, sustainability and seismic safety that can improve the performance of cultural heritage [5].

The paper analyzed articles that dealt with the history of the creation of the old city fortress, through the identification of objects within its borders [6–12]. The results of archaeological works were used, including documentation and pictures from the locality, in order to determine the condition of the objects that are the subject of research, as well as possible interventions for the purpose of restoration and conservation [6–9,11,12]. Studies dealing with new digital techniques of preserving cultural heritage, using different technologies for recording relevant architectural objects are being researched, through the goals of UNESCO [2], ICOMOS [3], and similar institutions, charters, and guidelines relevant to the topic [13–25].

The authors analyze the sources dealing with examining the magnitude and frequency of earthquakes in a given area [7–9] with the aim of rehabilitation and recommendations

for strengthening and improving seismic resistance of building with significant cultural importance, the most important principles of protection, and the possibility of application [10–15]. The properties of the historical masonry constructions in seismic zones are shown in the case study on the remains of the Dzephana Tower by presenting the different types of stone found in the environment and used in the building [26–28].

Moreover, the measures and the possibility of protecting buildings from future earthquakes, as well as the rehabilitation of old parts of the buildings of the City Fortress that were previously damaged by the seismic effect, were presented.

Based on studies conducted after earthquakes, both globally and locally, technical measures and materials are proposed for strengthening and improvement of the seismic resistance of the old walls of the fortress (injection, application of composites, reinforcements, etc.) [29–38]. In recent years, state-of-the-art techniques have been developed consisting of the use of fiber-reinforced polymers (FRP) as well as fabric-reinforced cementitious matrices (FRCM) [33,39].

In Sections 6.3 and 6.4 recommendations for the application of three levels of reconstruction are presented depending on the degree of damage due to the effects of the earthquake; we deal with techniques (non-invasive and invasive) that can be applied to the walls of the fortress, Motrilja Tower, as well as the restoration of the Dzephana Tower with old materials in combination with modern materials (in the future) [26,40]. In Section 7, the authors indicate the importance of preserving traditional buildings, along with their exploitation, in order to promote and valorize cultural heritage and activities related to organizing public events, through pictures and plans for future purposes. In conclusion, the authors suggest the need for better preservation of these buildings with the global issue of sustainability. A high level of protection of the historical heritage should be connected with the interests of the entire development community of the given area.

## 2. Research Methods and Study Area

### 2.1. Methodology

The structure of this work was designed through various scientific research methods. The analysis of the existing condition of the City Fortress in Novi Pazar was utilized to determine the conditions of the individual sections within the walls of the fortress. The backbone of the work is based on the application of analytical-synthetic and inductive-deductive methods, along with historical-descriptive and evidential-comparative methods. Through on-site visits (field exploration: measurements, comparisons, recording the actual condition) and documentation of material obtained on the basis of archaeological research, and the review of general literature, previous studies, and online material, an image was created that describes the way this architectural complex has lasted over time, which is also supported by numerous photographs from the field (authors). Based on the aforementioned analysis, specific places on the fortress suffered damage or ruination as a result of earthquakes or some other factor in the past. Based on numerous examples from contemporary architectural practice, a recommendation is given for the rehabilitation and reconstruction of the fortress in Novi Pazar, with the goal of achieving greater stability of the medieval architectural complex. In the conclusion, the method of synthesis is utilized of all used methods, generalizations, and specifications of all proposed measures in specific cases, as well as guidelines for further activities.

### 2.2. Study Area

This study should fill the gap that exists in the scientific literature on seismic reconstruction strategies in the area of Novi Pazar and its surroundings, and in particular has a purpose of analyzing possible seismic vulnerability mitigation measures, defining and removing possible barriers that limit the possibility of undertaking seismic interventions, and promote renovation activities. The proposed countermeasures, which will be discussed in the following sections with special reference to the case studies within the Fortress in Novi Pazar, can be effectively applied in other countries with similar disaster scenar-

ios and similar socio-economic origins, contributing to the effective improvement of the preservation of the cultural heritage of vernacular architecture in these areas.

The seismic effect on traditional construction can be understood and monitored by researching earthquakes throughout history, where the dates of seismic shocks, their intensities, and their magnitudes are analyzed. The higher the frequency and intensity of earthquakes in an area, the more pronounced the local seismic culture will be.

Serbia is considered to be part of the countries with moderate seismic activity, and the recorded earthquake magnitudes from 1900 until today have not reached a value higher than six units on the Richter scale. About half of the territory of Serbia belongs to zones from VIII to IX degrees. The territory of the city of Novi Pazar is located in a part that falls into the seismic zone of Kopaonik and is threatened with 8 degrees of the Mercalli scale. Kopaonik is one of the most haunted spots in Serbia. The last strong earthquake was in Kraljevo in 2010, with a magnitude of 5.4 units, with great material damage [41]. The area of Novi Pazar is located in the immediate vicinity of Kopaonik (Brus), and at a distance of about 100 km from Kraljevo.

The level of seismic hazard is largely determined by the occurrence of local moderate and strong earthquakes on the territory of Serbia. The largest number of strong earthquakes are located in central Serbia, so there is also the highest hazard. Since 1893, 27 earthquakes of magnitude  $M > 5$  have occurred in Serbia. The activity began in 1893 with an earthquake near Svilajnac, and the last strong earthquake occurred near Kraljevo in 2010. Strong earthquakes did not occur evenly throughout the area. According to earthquake magnitudes, Serbia is a seismically low to moderately active territory. Another parameter on the basis of which the danger of an earthquake can be assessed is the maximum magnitude. In Serbia, the seismic activity of faults has not been sufficiently investigated, so the value of the maximum magnitude can only be determined by statistical methods. Tensile stresses in the walls of masonry buildings easily exceed the tensile strength due to the action of even minor earthquakes due to the resulting opening cracks. Old masonry buildings are generally heavy due to thicker walls, which are not connected to each other, resulting in the collapse of individual walls, especially in the case of buildings with wooden ceilings [42]. The earthquake in Kraljevo in 2010 confirmed the seismic vulnerability of unreinforced masonry buildings due to low-intensity earthquakes. On most existing seismic hazard maps made for Serbia, this area has the highest or one of the highest values of maximum ground acceleration, or PGA (Peak Ground Acceleration).

When deciding on the strengthening of an existing building, the cost of strengthening is compared with the cost of reconstruction (replacement) of the building. Reconstruction as an alternative to strengthening is considered in the case when the cost of seismic strengthening exceeds 50% of the cost of reconstruction. In addition to the price, it takes into account the first degree of seismic vulnerability, the historical value of the building, the current purpose of the building, and other factors. There are a significant number of regulations and recommendations that provide guidelines for seismic strengthening of buildings and specific approaches and strengthening techniques depending on their material and constructive system. UNIDO [43] published one of the first publications on this topic, which was based on the experiences of the Balkan countries, including the former SFRY (Socialist Federative Republic of Yugoslavia), after the earthquakes that hit this region in the 1970s (Montenegro).

This research deals with the analysis of the most important principles of protection and the possibilities of application in the subject case study: the principles of authenticity and integrity, rehabilitation and recommendations for strengthening and improvement of seismic resistance for buildings of cultural importance, presentation of the interventions carried out on the building that is the subject of the research, and the presentation of the architectural heritage, in relation to different modern approaches [44]. An integral part of the seismic assessment of any historic building is knowledge of its history, the basic characteristics of the object, a detailed assessment of the actual condition of the structure and materials, and monitoring their behavior in terms of defining guidelines for treatment and action.

Construction models adapted to new buildings are generally considered inappropriate in the case of restoration of cultural heritage buildings [45]. The principles of authenticity and integrity are important postulates in the context of cultural heritage protection.

The principle of authenticity refers to several aspects [46]:

- Authenticity of materials—the techniques used to maintain material heritage speak of the level of civilization and human ability to recognize the original material and installation procedures and to compare them with the location of the building, as well as its aesthetic aspects.
- Authenticity of form—a work of art is the result of human work through the creative aspect of authenticity. In addition, it testifies to the duration of that work, its maintenance, and changes, which should also be authentic.
- The authenticity of goals and ultimate intentions is achieved by preserving the artistic level that determines the work of art. In addition, there is also the authenticity of the crafts, the authenticity of the place and the way of installation, as well as the authenticity in relation to the surroundings.

Integrity is another key principle of heritage source identification and definition. It refers to the identification of the functional and historical conditions of the origin of the historical building [47]. Both concepts are focused on the ability of the observed heritage to convey its significance. In the case of authenticity, it primarily refers to the significance and cultural value and, in the case of integrity, to the management and maintenance of the site in the future, all with the aim of preserving the significance and cultural value of the heritage over time.

In the territory of Novi Pazar, there is a rich and diverse cultural heritage, a treasure of inestimable value. The diversity of cultural heritage is the source of the spiritual wealth of mankind. Throughout history, Novi Pazar has always been attractive to conquerors that imposed their culture, which changed the way of life and business, in addition to the city's architecture and urban planning. A turbulent and rich history is the foundation of today's multi-ethnic and multicultural place where elements of Eastern and Western architecture intertwine.

Novi Pazar used to be in the center of the former Nemanjic state, and the most significant historical monuments originate from that period, such as Djurdjevi stupovi, St. Peter's church, Sopocani monastery, Ras medieval settlement, and others. The old town of Ras was the capital of the first Serbian state of Raska, during the time of family Nemanjic. The oldest record of Ras is from the 9th century (it is mentioned by the Byzantine Emperor Constantine Porphyrogenitus), and archaeological remains confirm that the area was inhabited as early as the late Eolithic, in 2000 BC.

Novi Pazar was mentioned for the first time in 1461, when the people of Dubrovnik had their consuls there and in Trgoviste, and in 1467. Turkish judges and city supervisors (kadis and subashes—Turkism), were mentioned in Novi Pazar. The founder of Novi Pazar was one of the most famous Turkish military leaders, Gazi-Isa-bey Isakovic, who is often mentioned in military campaigns against the western Serbian lands between 1440 and 1472. The history of multi-ethnic Novi Pazar testifies to various cultures and influences on the development of the city, and the dominant traces of the existence of Christian and Islamic culture which create a specific atmosphere and experience through their intertwining.

There are 30 cultural monuments under state protection on the territory of Novi Pazar, some of which have been on the UNESCO list of world cultural heritage for four decades. Cultural heritage includes tangible culture (such as monuments, landscapes, books, works of art, and artifacts), intangible culture (such as folklore, traditions, language, and knowledge), and natural heritage (including culturally significant landscapes, and biodiversity). Buildings of historic interest attract people from all over the world. It might be because of the buildings' historical roots, the materials used, the distinctive architecture, or some specific decorated element that people find fascinating. Historic and listed buildings increase tourism, provide job opportunities, and revitalize community.

History, after all, is a great educator. Getting to know the history of a community and its important historical buildings fosters a sense of belonging and community pride. The

buildings designs and construction reveal a great deal about the cultures that built them and the traditions and events from which today's society grew [48].

The systems of protection and use of cultural assets are regulated by law, as well as the conditions for carrying out cultural asset protection activities [49].

The Fortress at Novi Pazar stood out as an important element of the city's urban genesis. Its transformations from the military and administrative fortification of the "inner city" with loggias, warehouses, barracks, and a place of worship for the army to today's fortress, which incorporates a city park, is the embodiment of various influences that changed its function but not its character. In order to achieve international agreement on urban conservation, The Valletta Principles for the Safeguarding and Management of Historic Cities, Towns, and Urban Areas were adopted in 2011, which indicate the criteria for carrying out interventions in historic urban areas.

Today, this monument has a double status of protection: as an individual cultural monument and within a wider spatial cultural-historical unit with the old bazaar and the complex around the Altun-alem mosque.

### 2.3. New Methods of Preserving Cultural Heritage

One of the modern and innovative ways of preserving cultural heritage is its digital protection which consists of the processes aimed at ensuring the continued accessibility of digital materials [13,14]. Digitalization includes and develops all aspects of economic, scientific, and technological development. E-Europe creates conditions for cooperation and inclusion of all important monuments, sites, and institutions in the digitalization process, which will help record history, establish a digital library for researchers and public education, as well as enrich cultural vibrancy [15].

Unfortunately, the process of digitization of localities and monuments in the territory of Serbia is very slow. At the same time, these treasures are increasingly exposed to natural and human risks from climate change, fires, floods, earthquakes, etc. Until 2011, the area of the digitization of cultural heritage was not regulated by any legislative act in Serbia, nor did it have its foundation in strategic documents. However, the process of digitization, the use of information and communication technologies in culture, as well as multimedia and digital arts began to assume a strategic position and was given a legal framework within the "Law on Culture" adopted in 2009 [16].

The technologies involved in the digitalization projects are robotics, 3D scanning, machine learning algorithms, and artificial intelligence [17]. AI (artificial intelligence) and other advanced 3D and other technologies can help with the restoration and digitalization of tangible cultural heritage [18]. The European Commission has invested a large number of projects related to digital cultural heritage focusing on the digitalization processes [19].

E-funded projects for digitalization are:

- The RePAIR (Reconstructing the Past: Artificial Intelligence and Robotics meet Cultural Heritage) project: All artifact fragments are scanned using high-tech computers, which use machine learning algorithms to predict their original configuration.
- Scan4Reco (Multimodal scanning of cultural heritage assets for their multilayered digitization and preventive conservation via spatiotemporal 4D reconstruction and 3Dprinting) uses in-depth scanning cameras to create a high-resolution 3D replica of an artifact to transfer it into digital files.
- Laser scanning and photogrammetry are additional technologies that play a key role in the increased progress of digitizing cultural heritage [18].

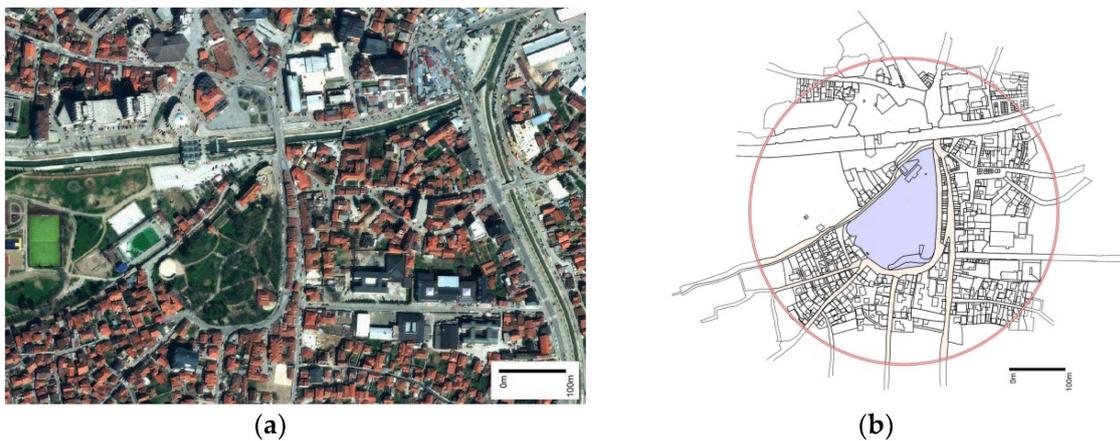
Joint initiatives were launched, such as for example "MICHAEL", in order to create a portal that would enable simple and quick access to digital holdings of cultural institutions in European countries and "EUROPEANA", a common source of cultural heritage of Europe [20]. It is expected that these systems of digitalization of tangible and intangible heritage of the multicultural and diverse environment of Novi Pazar in Southern Serbia will become a part of the national information system for management and preservation of this historical treasure [21,22].

The digitization procedure provides a “picture” of the cultural objects. The possibility for rapid prototyping of such objects inspired and intrigued many researchers [23,24]. Technology helps to identify culture and create endlessly connected experiences for visitors, whether on site or online [25].

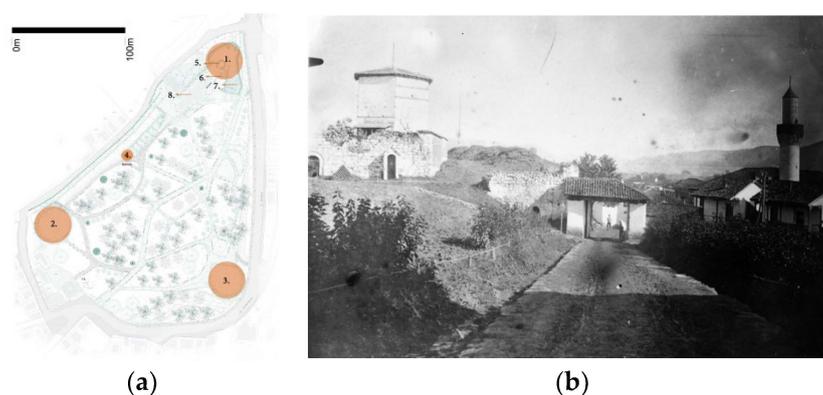
### 3. Property and Cultural Heritage Information

#### 3.1. Building General Information—Identification of the Building (New versus Old State)

The Novi Pazar Fortress is a medieval Turkish fort, built by Isa-bey Isakhovic in the 15th century when the city itself was established, at the crossroads of caravan routes that connected Bosnia, Dubrovnik, and the southern Adriatic with Constantinople and Thessaloniki. It is located in the city center, on the right bank of the Raska River, likewise covering the area of the city park. The fortification consists of three angular bastions—Tabias (original oriental word) and a tower known as the Stara izvidnica (Reconnaissance Tower), or Tower Motrilja (Watchtower) located between the northern and western Tabias. Tower Motrilja and northern Tabia were connected by a stone wall representing the only visible remnant of this kind of defensive walls [6]. Based on the remains of ramparts, Tabias, and half-buried ditches, it was established that the fortress had a triangular base formed by three corner Tabias, with a polygonal base of different dimensions (Figures 1 and 2).



**Figure 1.** Aerial view of the City Fortress. (a) Position of the fortress in Novi Pazar (photo source Geo Serbia); (b) City Fortress (drawing design: Lejla Zećirović).



**Figure 2.** Details of city fortress. (a) Scheme of the facilities of the City Fortress—Actual state: 1—Northern Tabia; 2—Western Tabia; 3—Southern Tabia; 4—Tower Motrilja; 5—Tower Dzephana; 6—Gunpowder tower—Bartuthana; 7—Zindan; 8—Modern-day Library. (Drawing design: Lejla Zećirović). (b) Entrance into the Fortress (Photo source: Tower Dzephana, 1916, private archive of Vladan Vidosavljević).

After the Turkish defeat before Vienna (1683) and the Austrian invasion of Skopje (1689), the Turkish authorities added a part of the former building in order to better protect it from further attacks by invaders. During the reign of Sultan Abdul Aziz (1861–1876), several buildings were built within the fortress: two new towers, a storage for weapons and ammunition, a smaller Askerli (military) mosque, and a new army barracks made of hard material [7]. In the imperial decree from 1717, it was indicated that the fortress had been built of lime and stone, but that it was damaged over time, so it needed to be repaired and expanded [8]. Moreover, it is written that six chardaks (Tukism, guardhouse, raised on pillars) and one tabia were restored and seven more chardaks were built. At the beginning of the 16th century, the courtyards were built of stone with loopholes present. The information about the restored Tabia probably refers to the present-day Tower Motrilja, which was probably built at the turn of the 17th and 18th centuries. This would mean that the “inner city” in 1692 consisted of palisade ramparts, a large number of chardaks, and the Tower Motrilja.

At that time, the fortress received its final form of an irregular triangular base, with three polygonal projecting Tabias. After the announcement of the reforms of Sultan Mahmut II (reigned 1808–1839) and the uprising of Bosnian feudal lords led by Husein-bey Gradasevic, about 30,000 insurgents were supposed to come to Novi Pazar, thus fortress underwent certain repairs in addition to the formation of a moat surrounding the construction, which strengthened the fortress even more. The fortress is depicted as such on a plan from 1879, which is kept in the War Archives in Vienna. The fortress retained its form and function until 1912, when Novi Pazar was liberated from Turkish rule. The Serbian army then demolished the mosque inside the fortress. The tower near the Northern Tabia was demolished in the First World War. The entrance gates, porches, auxiliary buildings and the Austrian chapel were also destroyed. A part of the stone wall from the Tower Motrilja on the northern Tabia was pulled down and removed in 1992, on the initiative of the mayor at that time.

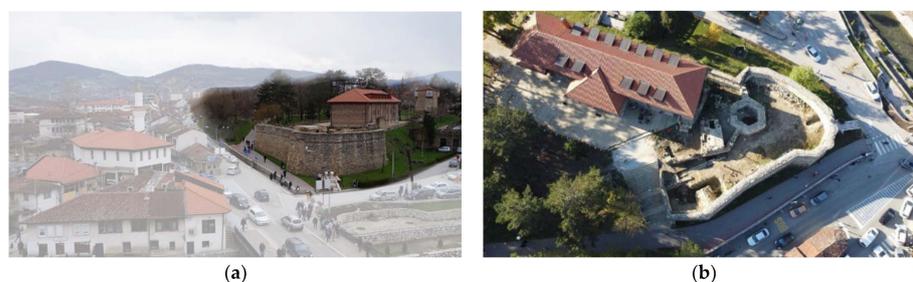
In 1916, a chapel was built for the needs of Austro-Hungarian soldiers on the site of the destroyed mosque. After the Second World War, the fortress was turned into a city park, the landscaping of which led to the mixing of cultural layers in its interior. The Tabias were conserved, and major conservation interventions were also carried out on the Tower Motrilja. The only building of the fortress that had and still has a purpose was the southern Tabia, where restaurant adaptations and summer garden landscaping were carried out on the plateau (unfortunately, without the prior consent of the protection service). A summer garden was also set up on the northern Tabia, which underwent conservation efforts once again in 2012 through a first place finish in a competition called “The place I love”, financed by Bank Intesa [30]. The thickness of the rampart walls is 1.30 m with the thickness increasing to 1.50 m in some parts. On the top of the ramparts, there were walkways and shooting ranges with spikes to protect the shooters. The fortress trench was dug around the city wall as an obstacle to invaders. It was dry and could be filled with water [9]. The fortress was the most visible facility in the urban structure of the city, elevated in relation to the bed of the Raska River, and very significant in terms of its historical position. This building received the status of fixed cultural assets of great cultural importance in 1979 [10].

The fortress was and remains a witness to history, wars, destruction, migrations, successes, and failures. Today, the interior of the fortress is used as a park, while the Tabias and the tower are independent facilities. The current library building was built on the foundations of the Abdul Aziz barracks (old walls from the 1930s [7] were found on the eastern wall of the northern Tabia). The space is active throughout the day: it experiences a lot of transit, but it is also used for rest and recreation, representing an oasis of greenery. It is a space where people can socialize, increase the sense of community, and help the development of tourism. However, although it offers great opportunities, the space is unattractive. Six unsteady centuries have passed since the creation of this important fortification, but not all of its parts have withstood the test of time, wars, and human carelessness, so the original functional scheme of all its parts cannot be fully understood. The priority is restoring of

all its parts to their new functionalities, devising the best tactics so that this area of urban conservation in the very center of the city becomes a favorite and vital place of the city's social life.

### 3.2. Analysis of the Part of the Facility

The fortress is located in the very center of the city of Novi Pazar, on the right bank of the Raska river, elevated in relation to its bed and within the city park. The fortress is connected to the oldest part of Novi Pazar, surrounded by the Old Bazaar on the east, residential quarters on the southwest and a gap (now a promenade) on the northwest side. The fortress occupies an area of about two hectares, the inner space of which is used as a city park. Through the park, there is a lively pedestrian connection between the center and the parts of the city where there are residential areas, the hospital and the stadium. As already said, the fortification consists of three corner Tabias, which are arranged in the vertices of an approximately isosceles triangle, with the top pointing north, and a tower known as Tower Motrilja located between the Northern and Western Tabia [11]. A stone rampart connects the Tower Motrilja and the Northern Tabia (Figure 3), representing the only visible remain of this type of defensive walls.

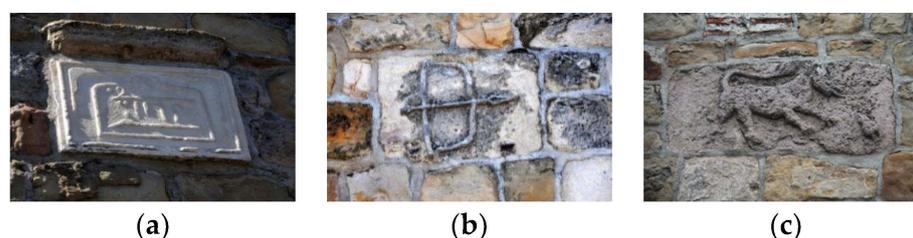


**Figure 3.** Northern Tabia (a) Tower Motrilja (Photo and design: Lejla Zećirović). (b) Modern-day City Library (Photo source: private archive of Vladan Vidosavljević).

#### 3.2.1. Bastion–Tabias

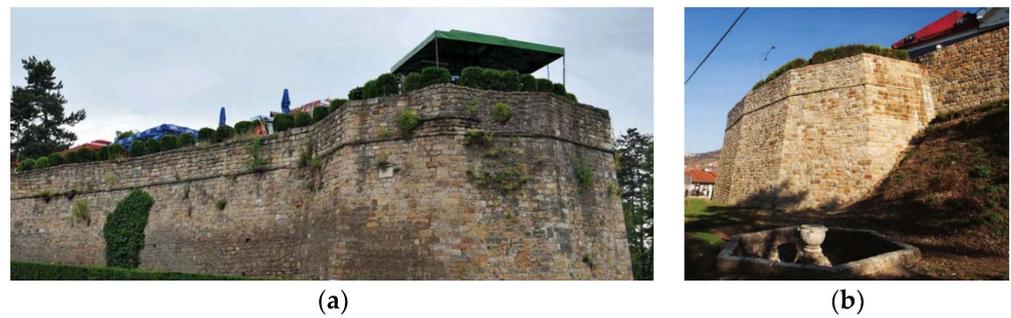
The Tabias of the fortress have polygonal bases of different shapes and dimensions, they are open to the interior of the fortress, and their upper platforms are flat. The walls are built with regular stone blocks in rows and spread outwards. Three Tabias are clearly visible on the walls.

During the construction of the Tabia, in some places, carvings with bas-relief representations of bows and arrows, birds and snakes, lions and decorative rosettes were incorporated, which were intended to symbolically secure the fortress from attackers (Figure 4).



**Figure 4.** Decorative rosettes on the walls of the Fortress and in buildings, symbols that drive enemies away from the Fortress (a–c) (Photo source: private archive of Vladan Vidosavljević).

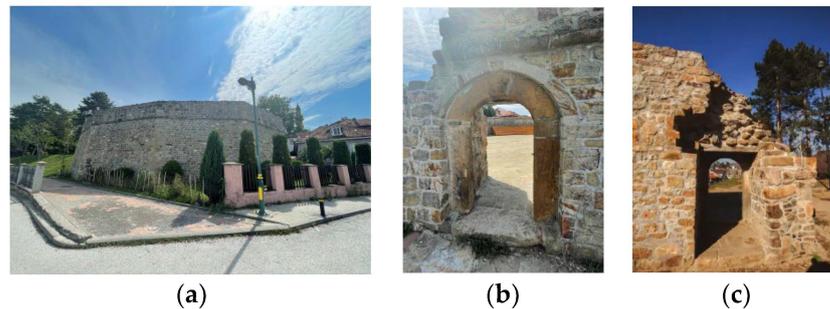
Tabias were the main elements of defense, according to the principles of artillery fortifications (Figures 5–7).



**Figure 5.** Northern Tabia. (a) North-south view (Photo source: private archive of Vladan Vidosavljević). (b) Eastern view (Photo source: private archive of Vladan Vidosavljević).



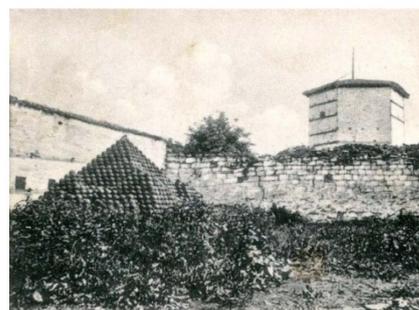
**Figure 6.** Southern Tabia: SW-NW view (Photo source: Lejla Zećirović).



**Figure 7.** Western Tabia. (a) SW-NE view; (b) western Tabia entrance portal—view from outside (c) western Tabia entrance portal—view from the inside (Photo source: Lejla Zećirović).

### 3.2.2. Tower Dzephana

The walls of the hexagonal Tower Dzephana (an ammunition storage facility) were discovered during the recent protective archaeological excavations at the fortress of Novi Pazar. Then it was established that this hexagonal tower was built at the beginning of the 17th century (Figure 8). In the coming period, it is planned to carry out a complete reconstruction of Tower Dzephana on the found remains.



**Figure 8.** Old Tower Dzephana (Photo source: private archive of Vladan Vidosavljević).

### 3.2.3. Gunpowder Depot—Baruthana

The Baruthana was the facility for storing gunpowder. It was recently discovered next to the remains of the Tower Dzephana. The facility is preserved, but the exact time of its construction is still unknown (Figure 9).



**Figure 9.** Baruthana. (a) Archeological site aerial view, (b) Baruthana entrance portal—view from outside (Photo source: private archive of Vladan Vidosavljević).

### 3.2.4. Tower Motrilja (Watchtower)

Of the numerous objects that were in the fortress, only Tower Motrilja or Sejr Kula (local name) has been preserved, an architecturally well-designed and shaped building with an octagonal base from which high walls were raised (Figure 10a). It served as an observation post with a wide field of vision to secure the ramparts from potential attackers. The tower is located between the northern and western Tabias, it is about 15 m high, and in the upper zone of the walls there are four musharabiyas (Turkism, loopholes), circular loopholes of smaller dimensions as well as some rectangular ones (Figure 10b).



**Figure 10.** Tower Motrilja. (a) Archive photo—Tower Motrilja in 1918 (Photo source: private archive of Vladan Vidosavljević). (b) Present state of the tower with the remains of the Turkish barracks from the period of Abdul Aziz's reign (Photo source: private archive of Vladan Vidosavljević).

The reconstruction of Tower Motrilja is a project of the Regional Tourism Organization of Sandzak (the value of the works is estimated at 22.7 million RSD, provided by the Ministry of Trade, Tourism and Telecommunications). Tower Motrilja is a spatial marker of the city; its reconstruction is in progress. A new function of the space was proposed for exhibitions, in the spirit of the environment (City Library and reading room nearby) for holding literary evenings, and as a summer stage.

## 4. Preservation, Protection Information, Archeological Research at the City Fortress

In 2020, archaeological research was carried out in the northern part of the city fortress of the southeastern part of the complex area with the aim of discovering the dungeon. For the purpose of the final presentation of this part of the fortress, it was necessary to determine the condition of the walls of the dungeon and the corridor leading to it, but also to find out the time of its construction and its relation to neighboring buildings. For this reason, the Municipality of Novi Pazar organized archaeological excavations in the eastern half of the northern Tabia, the removal of embankment layers by mechanization,

between 2.0 m thick on the southern side and 2.50 m on the northern side (archaeological excavations from September 30th to October 22nd of 2020, financed by the Ministry of Culture and Information of the RS, value 900,000 RSD). Thus, the missing data on the time of creation and parts of the fortress were obtained [50].

#### 4.1. Remains of the Dungeon—Zindan

The archaeological excavation conducted in 2020 revealed the following: The walls of the dungeon (zindan, Turkism), and the corridor leading to it are not structurally connected to the walls of the Tabia, which were not built at the same time [12]. From the outside, the dungeon shows several construction interventions during different time phases (Figure 11). The northwest corner of the entrance to the dungeon has been rebuilt, as well as its entire western wall, which can also be seen from the inside. The outer sides of the dungeon walls are rather crudely executed. The walls were made of broken and hewn blocks of sandstone, river pebbles, and bricks connected with lime mortar. The binding material was lime mortar. The space between the walls of the dungeon and the western and northern profiles was filled with a large amount of cinders and ashes as well as burnt fragments of bricks and roof tiles, which testifies that the building was destroyed by fire. The floor was most likely made of lime plaster, but it was completely burnt and its appearance is preserved to a lesser extent on the inner side of the south wall.



**Figure 11.** Excavation of the dungeon. (a) Aerial view of the site. (b) Present state of the remains of the dungeon (Photo source: Lejla Zećirović).

The remains of two more walls were discovered in the area between the dungeon and the southern wall of the Tabia. The northern wall is 3.75 m long stretches from the central part of the wall of the corridor that led to the dungeon and is drawn under the western profile. Its width is 1.15 m and its preserved height is 1 m. Along the wall, the remains of wooden columns with different diameters—from 0.10 to 0.25 m—were discovered. The wall is basically made of river pebbles, while above are broken pieces of sandstone and river pebbles connected with mud. Fragments of bricks and tiles can also be seen in the structure of the wall. The north face was executed much more carefully and was grouted with lime mortar. The space between the walls and dungeon corridor was filled with a layer of soil with the remains of burnt material about 0.40 m thick. In the aforementioned layer, there was a large amount of tile fragments—some of which were deformed due to the high temperature, then cinders and ash, as well as ceramic fragments showing damage caused by exposure to high temperature. A building was erected over the remains of the northern wall, which was of wooden construction, and the southern wall was also built for the purpose of strengthening the wooden columns [12]. Based on the movable archaeological material discovered in a layer of burning material, it could be said that the older building suffered during the 17th century and that this most likely happened in 1689 [7]. Excavations so far have shown that in this part of the Tabia, it can expect to find more buildings that preceded the time of the construction of its wall fabric. Future research will show whether the buildings were part of a civilian settlement or related to an earlier fortification.

#### 4.2. Remains of the Tower Dzephana

The Tower Dzephana is a hexagonal building of smaller dimensions at the base, next to the northern Tabia of the fortress. Based on the remains (Figure 12) found by archaeologists from Novi Pazar, Sjenica, Belgrade, and Sarajevo, this hexagonal tower was built at the beginning of the 17th century, and not, as previously thought, in the 18th century (based on written documents) [12].

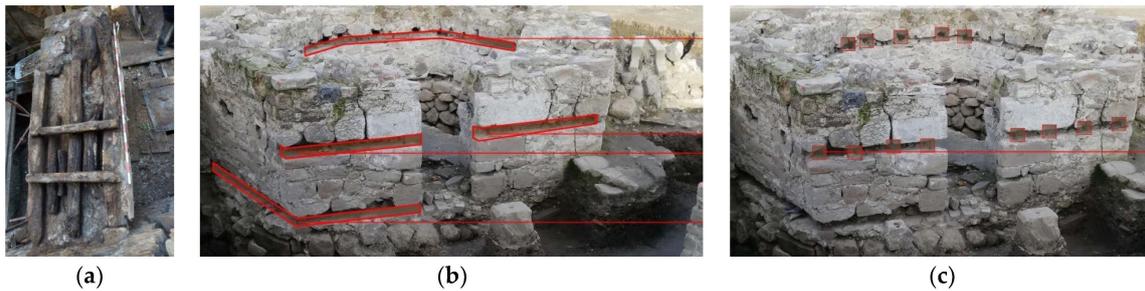


**Figure 12.** The remains of the tower Dzephana found on the northern Tabia, next to the dungeon. (a) NE-SW view; (b) aerial view; (c) on-site view (Photo source: private archive of Vladan Vidosavljević).

The entrance to the tower was located inside the southwestern wall and was 0.70 m wide. The tower was built from hewn blocks of sandstone and trachyte and river pebbles bound with lime mortar, and the filling consisted of pieces of sand and trachyte, river pebbles and fragments of bricks with lime mortar. The structure of the walls was strengthened by placing wooden beams in the walls of a rectangular cross-section, along with semi-shaped beams connected with iron wedges which were placed transversely in relation to the walls. The outer walls of the tower were plastered and painted, and the inner walls were only plastered. Two phases are visible on the floor surface of the tower, the younger lime mortar and the older stone slabs. The foundations of the tower were made of river pebbles arranged in a regular sequence in four rows and flattened from the outside in relation to the walls. The height of the foundation of the tower is about 1.00 m.

#### 4.3. The Reconstruction of the Tower Motrilja

The authenticity of the tower is reflected in the completely preserved architectural structure of an octagonal shape, with four cantilever outlets for musharabiyas (loopholes), the only ones preserved in this area (see Figures 12 and 13). The first conservation and restoration works were carried out in the eighties of the last century, when the stages of external plastering were removed and cleaned and plastered (filling the connections with lime mortar and lime milk using a special rubbing technique), the musharabiyas were rebuilt and again plastered and painted. The roof structure has kept its original shape, all the original beams that were in good condition have been kept, those that have worn out have been replaced with beams treated in such a manner as to not differ from the originals (neither in terms of color nor texture do they spoil the appearance of the old beams). Tiles were used as roof covering [10]. Recently, the reconstruction of the building of the tower was carried out according to the conditions set by the Republic Institute for the Protection of Cultural Monuments. The appearance of the tower has not been changed; it has remained authentic to its origin.



**Figure 13.** The remains of the tower Dzephana. (a) Wooden construction for reinforcement (from Hilandar monastery, identical to the construction of Tower Dzephana). (b) Molds of the longitudinal beams on Tower Dzephana. (c) Molds of the transversal beams on Tower Dzephana (Photo source: private archive of Vladan Vidosavljević).

#### 4.4. Gunpowder Depot—Baruthana

The Baruthana is a brick-made building positioned south of Tower Dzephana and is located in its immediate vicinity. A majority of the building is buried underground. It is surrounded on the southwest and southeast sides by walls between 0.80 m and 1.10 m thick, which were made of pressed stone blocks, river pebbles, and fragments of brick and tiles. Mud and lime mortar were used as binding material. In some places, there are visible traces of plastering—the rubbing of mortar into the brick joints. Wooden beams that were placed parallel to the length of the walls have been partially preserved in the facade. The described walls were in the function of trenches. The upper side of the vault of the powder room was covered with earth and river pebbles, but that layer was very poorly preserved. The powder room was entered from the northwest side through a passage 1.46 m long and 1.10 m wide, which was built later than the rest of the building. There are two openings in the southwestern wall, at ground level, and one in the northeastern wall. The openings were partially closed with stone slabs and served for ventilation. The vault is 30 cm thick and was painted on the inside [12].

#### 4.5. The City Fortress Foundations

The fortress was built on solid ground. The width of the stone wall of the fortress is about 1.30–1.50 m, and the binding agent used was lime mortar. It is founded in 220 million year old clay slate rock. The fortress (with all Tabias) was built on shallow grounds, on the same rock as the Tower Motrilja. The buildings were built at the same time, but they were not originally connected as the connecting walls were built at a later date.

### 5. The Property of the Historical Masonry—Constructions in Seismic Zones

The cultural significance of many protected historical buildings refers to their totality. Historical construction is important because it testifies to the levels of construction skill and daring of the builders of a certain era. Based on the study of the behavior of buildings during history and their structural elements due to seismic activities, a rational solution of structural rehabilitation should be achieved that does not violate the original structure, but builds on it and improves it, preferably with compatible and reversible materials and techniques [51].

#### 5.1. General Aseismic Characteristics of the Historical Masonry Buildings

In the case of historical buildings, there are great differences in terms of the structural assembly, construction techniques, and properties of the construction materials used. Generally speaking, masonry structures “attract” significant seismic forces in proportion to their mass and are not sufficiently resistant to tensile and shear stresses due to their low elasticity and relatively low capacity for stress redistribution. Research has shown that the seismic resistance of these buildings varies depending on the type of soil and method of foundation, architectural form, original quality of their constructive elements and con-

struction techniques, methods of maintenance, and various other factors. The aseismic characteristics of traditional construction in general is confirmed by the very existence of authentic very old buildings in the most pronounced seismic zones [52]. Most of the historic buildings are built of stone and/or brick. Brick structures are not capable of withstanding any tensile forces, so it is necessary to have such load-bearing systems in which the forces for “dead and live” loads do not occur in the structure or their effect is minimal. Only compression forces occur in constructions. The preferred load-bearing systems of masonry structures are arches, vaults, domes, massive walls, and massive columns, of appropriate sizes, to ensure their stability and safety, as well as the stability and safety of the entire building even in the case of small tensile forces (cracks). Brick buildings can be partially or completely damaged during seismic events, depending on their characteristics. Two different types of collapse were identified: first-order mechanisms (overturning, vertical arching effect, horizontal arching effect, and corner overturning as the main damage) and second-order ones (diagonal shearing, sliding shearing, and compression-bending). The first mechanisms occur when the connections between structural parts are not effective, while the latter are detected when the building has a box-like behavior and exhibits global instability [4]. Many historical buildings are located in seismically active areas, so it is necessary to define new techniques that allow an increase of the seismic capacity, while respecting conservation requirements. The seismic project of rehabilitating an old building that is deteriorating over time can refer to the construction of a completely new building, from the aspect of construction and materials, as well as the seismic protection project in the sense of “restoring” the original appearance of the building, with the removal of all subsequent changes (complete reconstruction).

The study of local seismic culture is vital to understanding how local resources and local geological features were combined with traditional construction techniques in the past. Architects and civil engineers who deal with the constructive rehabilitation and restoration of historical buildings accept the opinion that “weakness” does not mean old buildings, built without modern materials—steel, reinforced concrete, etc.: buildings, whether old or new, are not resistant to seismic shocks because they were built ignorantly, inadequately rebuilt, poorly maintained, etc., and they resist impacts thanks to quality building materials and techniques, as well as thanks to a successful architectural and constructive concept. One of the frequently applied directions in the reconstruction of architectural heritage after the earthquake is the use of old, traditional materials significantly improved by new technologies. Their application in the restoration of the architectural heritage enables the adherence to one of the basic principles of conservation: reversibility. Similar to improved old materials, completely new nano-materials enable delicate interventions that maximally preserve the original fabric of buildings that remained undamaged or slightly damaged in earthquakes.

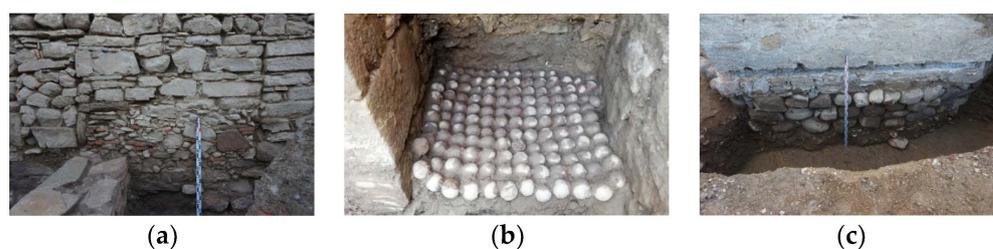
### *5.2. Construction Elements and Construction Techniques at the City Fortress*

The study of old construction techniques is important not only from the point of view of the history of architecture and construction, but also from the aspect of applying traditional or compatible modern construction procedures in the process of rehabilitation, reconstruction and adaptation of old buildings. Historical buildings in the territory of Novi Pazar and the surrounding area are masonry and massive, with stone as the basic building material and using lime mortar as a binder. This is also the case with the city fortress. The materials that were used for the construction of the fortress and later for the reconstruction of Tower Motrilja in 2012 were brick and different types of stone: sandstone, trachyte, andesite, and river pebbles. Lime mortar was used as a binding material. Traditional construction knows different types of lime mortars: with the addition of old oils, beaten bricks, “red” soil, etc. Old builders paid special attention to the openings in the walls (doors, windows) from the aspect of aseismicity: simple segmental or flat arches for load distribution were made above the windowsills and lintels due to reinforcement, usually on three joints [26]. Excavations of the remains of Tower Dzephana show that wooden ceiling beams were used

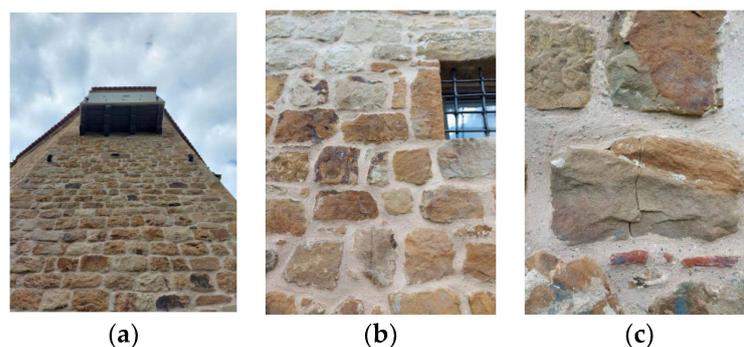
(Figure 13) that passed through the wall, assuming the function of tension. The half-forms were riveted with iron pegs to the wooden beams. A grill made of wooden beams was used as a support for the mezzanine construction and reinforcement in case of seismic activity.

As already mentioned, interventions were carried out on the destroyed parts of the building with identical materials, whose characteristics are known and confirmed, more commonly than with new materials, as they could cause a problem due to the lack of information about the properties and compatibility of the behavioral mechanisms of these materials. The use of inappropriate stone can result in significant damage to heritage [27]. The replacement stone on the damaged parts of the building should be of the same type as the original or the closest possible equivalent, with knowledge of its characteristics that should correspond to the original stone [28]. During the construction of the medieval fortification, the following types of stone were used (Figures 14 and 15):

- Novi Pazar sandstone: it is formed by binding sand, using natural binding materials. The color of this natural stone depends on many factors, primarily on the color of the binder used to create the stone: in yellow and brown, red, gray, or green shades. For this reason, the use of this stone was very diverse. Today, some of its types are also used when making foundations, and it is very resistant to temperature differences, especially when it comes to high temperatures, so it is often used to cover fireplaces with this stone, or exterior walls, and the like.
- Trachyte is an architectural-building stone that has been used for more than 1000 years. It was built into the church of Holy apostles Peter and Paul (8th century—perhaps older), used for the minaret of the Altun-Alem mosque from the 16th century, in Djurdjevi Stupovi, and on numerous churches and mosques in the wider area of Novi Pazar, as well as on the city fortress. (The name “trachyte” is the result of an error in a laboratory determination fifty years ago, formed from andesitic lava, of volcanic origin, formed several million years ago.
- Andesite appears mainly in the form of large masses (outflows), columnar, or bank-like secretions.
- River pebbles are also widely represented in the area of Novi Pazar, in different colors and granulations.



**Figure 14.** The use of the various stone stack for the construction of the city fortress. (a) Sandstone. (b) Cannonballs. (c) Brick and river pebbles (Photo source: private archive of Vladan Vidosavljević).



**Figure 15.** The use of the different types of stone on the Tower Motrilja. (a) On-site view. (b) Stone stack detail. (c) Deteriorated elements in the tower (Photo source: Branko Slavković).

## 6. Sustainable Strengthening and Seismic Improvement Techniques

Unreinforced masonry (URM) buildings are among the most common types of buildings in the seismically active zones of southern and central Europe. Some of them possess a high historical value and could therefore be classified as part of the architectural heritage, requiring special attention with regard to their preservation and retrofitting measures [29]. In order to achieve a better and standardized operation in Europe, on the recommendation of ENCoRE (European Network for Conservation—Restoration Educations), unique project provisions for the resistance of structures to earthquakes have been established, through codes that require checking the structural assembly of an object threatened by an earthquake in terms of strength and ductility [30]. According to Eurocode 8 (Design provisions for earthquake resistance of structures), the new structure of the building should be designed and constructed in a way to prevent its collapse and provide the necessary earthquake resistance [31].

### 6.1. Sustainable Repair and New Restoration Techniques; Proposal of Technical Measures and New Materials for Enabling Stability and Improving Seismic Resistance

Based on the analysis of seismic data in the last 120 years since earthquakes have been measured and monitored, the territory of Novi Pazar is not in the region of increased seismic activity. Regardless of these data, it is necessary to rehabilitate, reconstruct, and strengthen cultural heritage objects with appropriate methods in order to better respond to potential earthquakes. Parts of historical buildings have been demolished partly because of the time that has passed since their construction, partly because of earthquakes in the past, and often the cause is man (destruction by wars and the like). The epicenter of the earthquake most often occurs around Kopaonik mountain, which is near Novi Pazar, or in the part of central Serbia. Ground tremors of lower intensity (up to 2 degrees on the Richter scale) are present in the territory of Serbia almost every day throughout the year, but they do not leave any consequences on buildings [32].

The methods of seismic rehabilitation of buildings include various techniques for repairing the appearance and stability of structures, including effective parameters in improving seismic strengthening that can be applied to the buildings of the fortress. In order to preserve the stylistic integrity of the building and the longevity of the structure, a combination of old and new materials is most often introduced, as it has proven to be the least problematic and offers high quality. The performance of old materials is improved by new materials. The concept of building rehabilitation includes a set of measures to establish its stability in the event of an earthquake.

The technical measures necessary to establish the stability and resistance of the wall are [33]:

- Foundation consolidation,
- Connection of walls and floor structures,
- Strengthening the walls by grouting and/or injecting cracks,
- Reinforcement of masonry vaults,
- Renovation of existing floor structures or their replacement with new and solid structural elements,
- Reconstruction of the wooden roof structure, and
- Repair and strengthening of non-constructive elements.

There are different types of protection methods in practice from those that require strict adherence to traditional crafts and techniques to those that completely introduce new materials and constructive systems. The subject of many discussions is whether a better solution is to apply new techniques based on traditional materials whose long-term behavior is predictable, or to hurry with the application of materials that have not yet been sufficiently tested. The choice between traditional and innovative techniques should be weighed on a case-by-case basis and priority should be given to those that are least invasive and most compatible with heritage values, taking into account safety and durability requirements [34]. Defining an appropriate strategy for the rehabilitation of cultural

heritage objects is an important step in overcoming the consequences of earthquakes. Wall reinforcement can be done by:

- injection mortars
- composite materials
- reinforced steel
- connecting mezzanine constructions and surrounding walls with various types of connections
- strengthening of floor beams

The design of temporary interventions for the safety of the historical building starts from the measurement of the damage and from the identification of the collapse mechanisms activated by the seismic effect. The proposed interventions refer to:

- Interventions to improve connections
- Interventions to increase wall strength
- Interventions to reduce the flexibility of floors and their consolidation

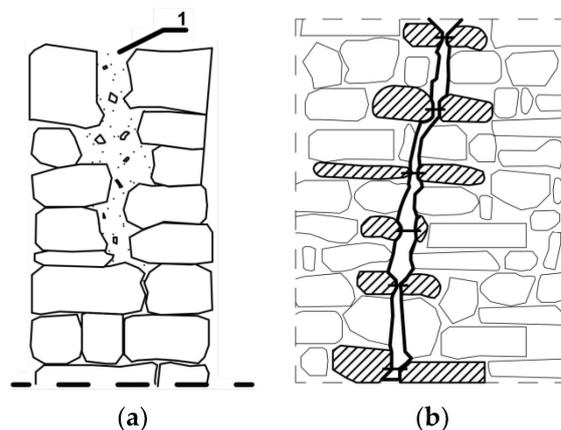
The general principles of wall strengthening refer to methods of repair, reconstruction, and strengthening [35].

- Repairs include operations that do not include the load-bearing structure, with the aim of improving the comfort of using the facility and repairing damage to non-load-bearing elements.
- Reconstruction includes the restoration of the supporting system of buildings to the level that existed before the damage occurred.
- Reinforcements include strengthening of the supporting structure (damaged or undamaged) to the level of the desired safety of the object.

Damage of the buildings depends on the layout of the load-bearing walls at the base, the connection between vertical elements and ceiling, and ductility. Depending on the place that needs to be strengthened, technical solutions are applied that increase the bearing capacity of the structure, increase the ductility, or increase both factors. Due to the effect of the earthquake, the wall may fail diagonally, when the wall is loaded with vertical and horizontal loads at the same time. Vertical load is constantly present, while horizontal load occurs occasionally, due to the effect of earthquakes or strong winds. Compressive strength depends on the strength of the masonry elements. Fracture most often occurs at the element itself and not at the mortar joint (whose compressive strength is much lower) due to the incompatibility of the characteristics of the masonry element and the mortar, as well as their non-adhesion to each other. Adhesion depends on the strength, consistency, and composition of the mortar, the quality of aggregates, the strength of the contact surfaces, their roughness, climatic conditions, etc. In practice, it is recommended to wet the wall elements before placing them in the mortar, due to better adhesion [36].

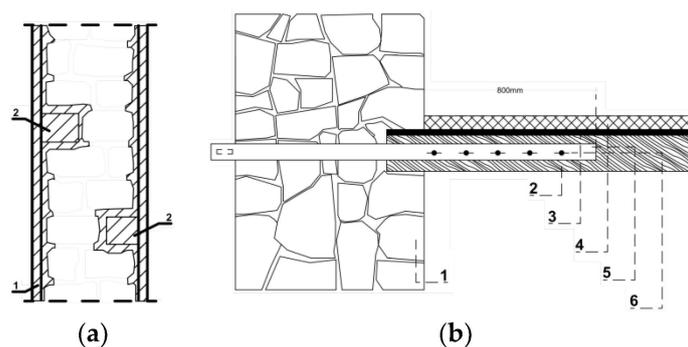
Injection mortars can have different ingredients, depending on the dimensions of the cracks and fissures, that is, on the dimensions of the opening that is filled with the injection mass. The following can be used for grouting: epoxy resins, cement suspensions, cement mortars, polymer-cement mortars, and epoxy mortars. Quartz flour is most often used as a filler in the mentioned mortars. Finely divided mineral materials (bentonite—a kind of clay of volcanic ash, natural and artificial pozzolans, used as a filler) are used as additives for making injection mixtures, and plasticizers and aerants (air entraining admixture) are used as chemical additives. Epoxy resins are used for injecting cracks up to 0.3 mm wide. Other types of injection mortars are used for injection of cracks wider than 0.3 mm, cavities, injection of prestressing cables, etc. (Figure 16a). Cracks wider than 0.3 mm can be filled by injecting liquid cement mortar, and in special cases epoxy materials are used. Injection of cracks can be omitted if the reinforcement of the shotcrete wall planned to be done by injection of water-cement mortar in nozzles, under pressure. Injection can also be used for larger cracks up to a size of 10 mm. The injection procedure is carried out step by step: first, the plaster around the crack is removed, using a jet of water or pressurized air. Then along the crack, at lengths of 300 to 600 mm, holes are drilled into which plastic tubes are placed

at a depth of 50 mm, fixed with cement mortar. Cracks are filled with cement mortar along the entire length. The tubes are plugged and then, by opening the plugs in pairs, the crack between the adjacent tubes is washed or blown out. Injecting is done under low pressure, from the bottom up, and the emulsion starts to flow on the first upper tube [36]. Instead of tubes, the grouted wall can be strengthened by inserting clamps at the grouted places (Figure 16b).



**Figure 16.** Technical details: (a) Stone wall with points of mortar injections. (b) Clamps or fittings perpendicular to the cracks in the wall (Drawings: Lejla Zećirović).

Composite materials are materials composed of two or more components, where the mechanical characteristics of the material depend on the mechanical characteristics of the components. In practice, most composite materials are composed of a base material (matrix) and reinforcement (a material that provides strength). In construction practice, epoxy resins are most often used as a matrix, and glass, aramid, or carbon fibers as reinforcements. Steel clamps, reinforcement, or reinforced concrete beams can be installed directly on the cracks (Figure 17a). Cavities can also be filled with concrete, thus strengthening the entire wall. In the case of significantly damaged walls, it is often necessary to replace entire parts of the wall mass, where it is first necessary to temporarily support the structure located above the damaged wall. In the case of visible dislocations of a part of the wall, the existing wall should be removed and a new one made of the same material should be rebuilt. One of the ways to rehabilitate and strengthen walls damaged by an earthquake is reinforcement. The reinforcement bar is attached to the pre-cleaned wall that has open joints and cracks, by inserting vertical and horizontal ring beams, while injecting the filling mass. Cement mortar M30 is applied to the reinforced wall in a thickness of 3 to 5 cm. Another way is to install concrete “niches” (Figure 17b). In order to increase the rigidity of the existing floor structure, reinforcement is recommended, with the use of steel clamps on both sides of the walls (attached to the wooden floor structure). Damaged and dislocated walls should be rebuilt with the same material but of better quality or reinforced with ring beams [48]. Part of the facade can be connected to the rest of the building, using wooden beams—tensioners and iron anchors, so-called “keys” (Figure 17b). In this way, during an earthquake, due to stress concentration, the creation of cracks and the collapse of the walls would be prevented. Blocks of stone can be connected to each other with metal anchors, in order to act on the principle of a chain [37].



**Figure 17.** Technical details: (a) 1—Reinforcement with the reinforced cladding; 2—connection with the wall by concrete “niches”; (b) connection of a wooden mezzanine structure to a stone wall: 1—existing stone wall; 2—existing wooden beam; 3—wooden mat; 4—new cement screed; 5—steel strip; 6—elsers (Drawings: Lejla Zečirović).

Strengthening of floor structures is performed by placing diagonal connecting beams if the floor structure is wooden, with anchoring of wooden beams in the walls. For such interventions, a static calculation is necessary. Renovation of the roof structure involves replacing damaged parts of the structure with new ones and installing a new roof covering (tile, in the case of Tower Motrilja).

It should be mentioned that there are two conflicting opinions of researchers, considered to be two schools: on the choice of materials for the parts to be added: French and Italian. According to the French school, new parts of the building should be made of the same material and processed in an identical way as the original parts—a replica, a “fake”. The Italian school advocates a completely opposite opinion: that the new parts are embedded into the original with a general impression, but should differ in processing or construction in order to make these additions visually distinguishable on the building itself [38].

This issue was resolved in the Athens Charter (adopted in 1933, contributed to the internationalization of cultural heritage) as follows: “The restoration of the original parts to their former place is recommended when the situation allows; the necessary new materials in that case must be such that they can always be recognized”.

The Venice Charter (International charter for the conservation and restoration of monuments and sites, 1964) states: “The additions that are supposed to replace the missing parts must fit aesthetically into the whole, but still differ from the original parts, so that the restoration does not represent a falsification of the documents of art and history.”

## 6.2. The New Materials

Building conservation and preservation techniques should be directly related to researched materials and technologies for construction, repair and restoration of built heritage. The chosen intervention should respect the original function and ensure compatibility with existing materials, structures, and architectural values. All new materials and technologies should be precisely tested before use because their properties and behavior can change over time and threaten the structure of cultural heritage. In the past, there have been many missteps in the use of materials and restoration techniques that have irreversibly compromised the appearance (or even the continued existence) of many works of art. The use of modern materials, as a substitute for original materials, is suitable only if it meets several prerequisites:

- provides a significant, identifiable advantage;
- their use has a solid scientific basis;
- their use is supported by experience.

In the case of using new materials, it is necessary to choose those that are compatible with their expression, appearance, texture, and shape of the original pieces. New materials

should also meet the requirements of the physical and geographical characteristics of the climate, as well as the local way of life of the population [4].

Epoxy-based materials are most often used. When using these materials, it is necessary to determine the compatibility of their physical/mechanical properties (density, linear thermal expansion) during bonding, the volume, the size of the joint to be filled and the temperature around the joint to prevent stress between the resin and the surrounding structures. Emerging building materials that can be applied for cultural heritage interventions are smart materials, fiber-reinforced composites (FRP) suitable for repairing and strengthening structures, geomaterials for improving terrain properties, aluminum materials suitable for protective structure construction, often combined with glass or transparent plastic, polymer-modified mineral materials (mortars, concrete), and materials for wall modification mainly based on polymers [33]. In recent years, innovative techniques have been developed consisting of the use of fiber-reinforced polymers (FRP) as well as fabric-reinforced cement matrices (FRCM). Both methods have proven to be effective in terms of increasing the capacity and ductility of masonry elements without overloading the structure with additional weight. The use of FRP fibers is almost irreplaceable in the restoration of cultural assets from the consequences of earthquakes. FRP composite materials are available as ready-made factory products in the form of strips, fabrics, and rods that are joined with suitable adhesives (most often epoxy-based) for the external surfaces of the structural elements to be strengthened. FRP composites can be used to strengthen wall units or only individual wall segments. Reinforcements include FRP strips placed horizontally, vertically, and diagonally, as well as a combination of vertically placed FRP strips and horizontally placed FRP bars [39]. The advantage of strengthening masonry structures using FRP products, compared to traditional reinforcement techniques, is minimal additional weight, quick application, increased resistance to pressure, and impossibility of breakage by cracking.

One of the directions in the reconstruction of the architectural heritage after the earthquake is the use of old, traditional materials significantly improved by new technologies. Their application in the reconstruction of architectural heritage enables the implementation of one of the basic principles of preservation—reversibility. However, when FRP systems are used with epoxy resins, despite their advantages in overall structural performance, they are considered less viable due to low fire resistance, high sensitivity to ultraviolet light when exposed to open air, high toxicity, and unsatisfactory durability. The FRCMs, on the other hand, combine a fiber-reinforced mesh embedded in a high-performance, sprayable cement matrix and overcome most of the disadvantages arising from the use of epoxy resins as a bonding agent [53]. The FRCM technique is often considered a “green solution” because it involves the use of fiber-based meshes embedded in an inorganic (cement or lime) coating, instead of the epoxy resin used as a matrix for FRP systems. In addition to improving structural safety in the event of seismic events, FRCMs enable the reuse of existing material, which is an advantage in terms of sustainability and reduction of raw material use. The use of an inorganic matrix (lime or cement) has very positive characteristics in terms of “compatibility” between old masonry materials (lime, stone, brick) and new ones. The compatibility of new and old materials is the most important prerequisite for obtaining good and lasting results in the rehabilitation of cultural heritage buildings. Similar to improved old materials, brand new nano-materials enable delicate interventions that can maximally preserve the original fabric of buildings that have remained undamaged or slightly damaged in earthquakes. The latest materials research based on nanoparticles and the study of physical and chemical phenomena at the nano scale create new approaches to the science of preservation of historical monuments, which leads to new methodologies that restore the original appearance of cultural heritage buildings. The combination of different nanotechnologies allows today’s conservators to provide interventions that respect the physical and chemical characteristics of the materials at each step of the restoration. They are used in the restoration process [54]. The future will show whether it has moved in the right direction.

The Venice Charter (1964) addressed the problem of use of modern techniques in its Article 10: "Where traditional techniques prove inadequate, the consolidation of a monument can be achieved by the use of any modern technique for conservation and construction, the efficacy of which has been shown by scientific data and proved by experience".

### 6.3. Proposed Reconstruction Measures

The type of measures and methods that will be applied in order to increase the resistance of the specific object depends on the building configuration, the type and quality of the material from which it was built, the degree of damage, as well as the level of resistance that should be achieved. The final decision on the method of rehabilitation, i.e., strengthening, should always be based on the appropriate calculation, engineering decision, data related to the assessed condition of the object, including its damage, type, and quality of the material from which it was made.

Strengthening and rehabilitation of the existing supporting system includes various interventions [40]:

- strengthening by walling up individual walls in the construction system;
- introducing new walls into the basic construction system;
- connecting the construction of the walls at the level of the inter-floor constructions.

Considering the degree of damage, the literature recommends the application of three levels of reconstruction [55]. Each of the proposed levels has its own specific characteristics that are reflected in the details. By applying these levels, the structural assembly, purpose, or area of the space does not change. Each of the proposed levels can be applied separately, with a time distance from the previous level.

The reconstruction and rehabilitation process itself should be the least invasive and the most cost-effective, with the use of light materials and simple techniques. By applying one level or combining several at the same time, the overall earthquake resistance of the building increases.

Level 1 is the simplest and includes restoring the building to its original state, before the earthquake, while strengthening all parts of the building that showed particular vulnerability to the earthquake. Construction calculations are not necessary for this level of rehabilitation. The measures include the following procedures:

- Repair of observed cracks and wall damage (filling with mortar and FRP protection)
- Rehabilitation and stabilization of the roof structure and roof covering
- Connecting the floor structure and the surrounding walls
- Strengthening walls (grouting and filling cracks)
- Connecting the walls (the estimated value of the work performed at this level is 90–95 Euros/m<sup>2</sup> [26]).

Level 2 is more complex than level 1 and its main objective is to strengthen the building in order to increase its resistance to earthquakes by a minimum of 50% of the resistance required for new buildings. This level involves the analysis of the entire building by an authorized construction expert, with the goal to make a static calculation of all damaged places on the building. Reinforcements are most often made with FRP products. Depending on the scope of the planned works, the estimated value is 70–165 Euros/m<sup>2</sup> (the price varies if the works are performed on this level or in combination with level 1) [26].

Level 3 is a superstructure of level 2 because it requires even greater resistance and, therefore, more extensive works with the preparation of project documentation of the construction project and seismic classification of the building, with the requirement to achieve 75–100% resistance to the effects of earthquakes of the new building. The estimated value of the works on this level is 230 Euros/m<sup>2</sup>, and if the works are combined with the works performed on level 1 and level 2, the estimated value of the works goes up to 400 Euros/m<sup>2</sup>.

In case of implementation of all three proposed levels, the total saving is about 15% compared to the case where each level is done separately [26].

#### 6.4. Structural Damage Restoration Techniques

The most commonly applied structural restoration techniques are:

- non-invasive technique
- invasive technique

##### 6.4.1. Non-Invasive Technique on the Example of the City Fortress Walls and Tower Motrilja

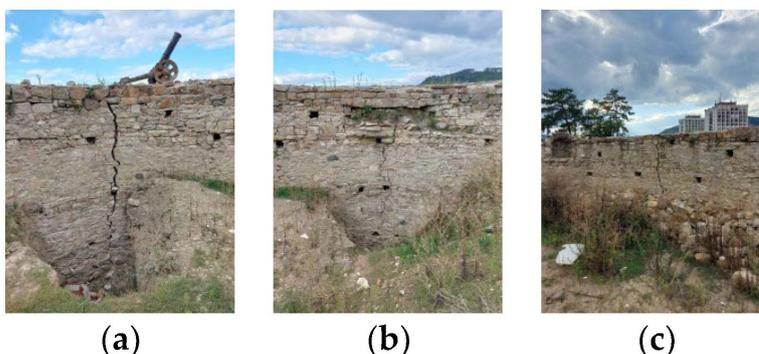
When planning the rehabilitation techniques, the following conditions should be taken in consideration: that the concept of the building should not be changed during rehabilitation interventions, that the architectural appearance of the building remains authentic, and that the investment costs are as low as possible [38]. All these conditions are met, and it is possible to apply them in the rehabilitation of the walls of the fortress, dungeon, and Tower Motrilja because the levels of damage are almost identical and the construction material is the same (as well as the recommended rehabilitation techniques). The basic principle of this technique is that dilapidated structures, whenever possible, should be repaired rather than replaced with new ones.

The most common and important structural problems that need to be solved in the rehabilitation of the city fortress and the buildings within its walls are due to ground subsidence or damage caused by collapse due to deterioration over time, the effects of natural disasters (earthquakes), or ancient war destruction.

The actual condition of the walls of the city fortress was determined on the site. Although the walls look quite solid from the outside (Figure 18), the situation is quite different from the inside of the walls of the fortress (Figure 19): clearly expressed vertical cracks are visible, which should be filled and strengthened by the injection methods already mentioned (Section 6.1, Figures 16 and 17). The wall was repaired only from one side, which is unacceptable. This issue should be approached studiously and repair and strengthening of all walls, on both sides should be performed, as well as foundation consolidation.



**Figure 18.** The walls were repaired only from the outside (Photo source: Branko Slavković).



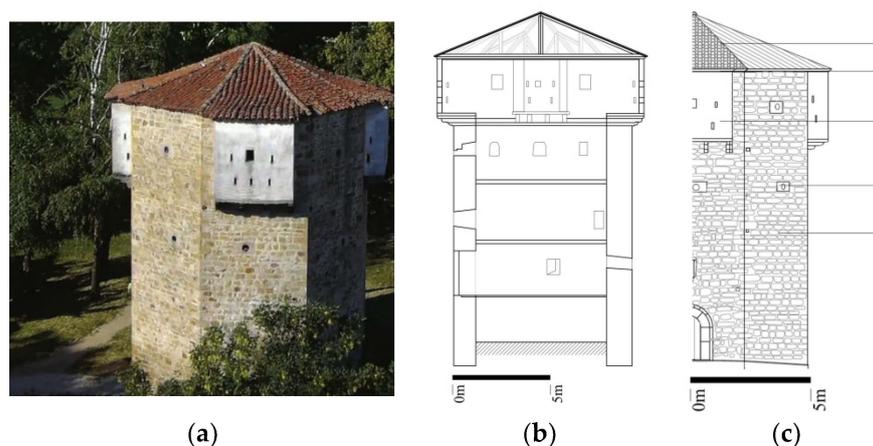
**Figure 19.** Cracks on the walls of the fortress—northern Tabia. (a) Inside view—northern position; (b) inside view—eastern position; (c) inside view—western position (Photo source: Branko Slavković).

Before proceeding with the rehabilitation of cracked walls, it is necessary to assess the extent of mechanical damage in cracked structures, detect the presence of cavities and defects, assess moisture content and capillary growth, detect surface deterioration, and assess the mortar and the mechanical and physical properties of the stone.

In addition, consolidation of the foundations should be carried out, which includes their rehabilitation by soil reinforcement, jet grouting, repair with expanding compounds, or insertion of micro-piles. This way, the tension in the soil will be reduced and the building will be weighted at the foundation level. The goals of the injection technique are to fill cracks, thereby increasing the continuity and strength of the wall, and to fill the gap between two or more layers of wall when they are poorly connected.

Towers, as prominent parts of buildings, should be strengthened due to the danger of overturning or excessive tilting of walls and columns, with the consequent collapse of the roofs and floors they support. In the example of Tower Motrilja, methods for rehabilitation are presented, which include the technical measures provided for in the text above. The rehabilitation and renovation of Tower Motrilja included the measures proposed under level 2, Section 6.3.

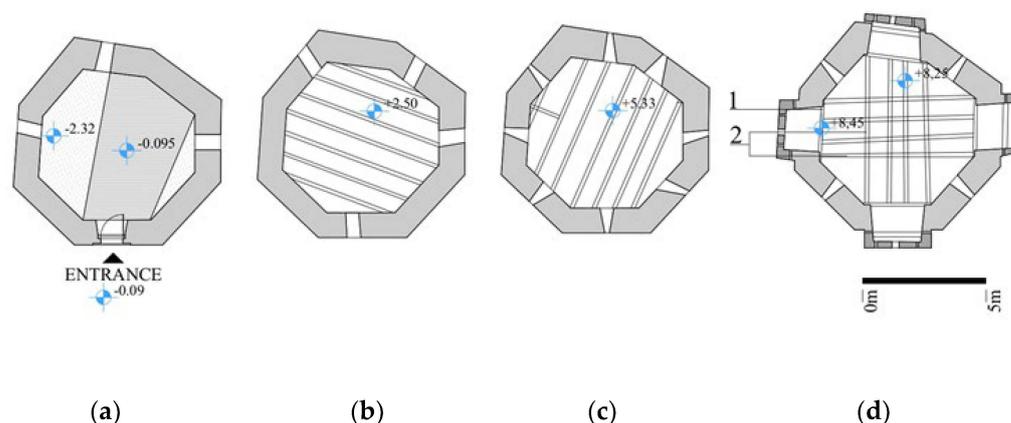
Using the regulations for eliminating the consequences of the earthquake, the practice and suggestions of the Institute for the Protection of Cultural Monuments, the proposed and implemented actions for its recovery are shown in the following text. In order to preserve the original features of the building and solve the construction of the tower, it was necessary to keep the shape of the mezzanines and replace worn-out material due to the introduction of a modern function into the building (Figure 20).



**Figure 20.** Tower Motrilja. (a) On-site aerial view (Photo source: private archive of Vladan Vidosavljević). (b) Cross-section of the tower. (c) Detail of the materialization of the façade: 1—limestone stack; 2—circular loopholes; 3—brickworks; 4—profiled roof cornice; 5—roof tiles stack (Drawings: Lejla Zećirović).

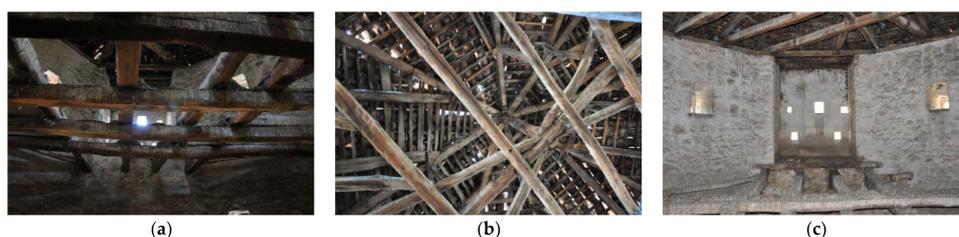
Tower Motrilja has five floors (Basement + Ground +2 Floors +Attic), built in a massive structural system, with facade walls 1.30–1.50 m thick, made of stone, with lime plaster as filling.

The foundation of Tower Motrilja is polygonal (octagonal), with a total width of about 8.30 m (Figure 21). The constructive system of Tower Motrilja consists of massive walls, which are also facades, 13.5 m high, stiffened by mezzanine wooden ceilings stretching in two directions, alternately by floor levels. In the last floor, triple multiplication of wooden beams is planned for the formation of musharabiyas. The walls of the musharabiyas are built with bricks, due to their lighter weight, and after plastering they will be painted white.



**Figure 21.** Base of the Tower Motrilja. (a) Ground floor. (b) First floor. (c) Second floor. (d) Attic: 1—wooden beam; 2—slat; (Drawings: Lejla Zećirović).

The wooden mezzanine structures are cross-oriented on the floors, they extend vertically in relation to each other. The footings are placed crosswise on two adjacent floors in height, as in the existing structure where it is made of wooden beams. On the floor below the attic, the existing subfloors are retained, which extend in both orthogonal directions on this mezzanine structure. On the part of the staircase, they rely on new beams of the same dimensions and on the subfloors of all lower levels, accepting the new designed load while retaining the existing wooden beams. The central mezzanine structure is designed entirely from pipes with a rectangular cross-section, dimensions  $200 \times 120$ ,  $t = 8$  mm, according to the calculation of the two most heavily loaded parts and the subfloor of the largest span. Due to the repurposing of the building and meeting the minimum conditions of fire protection, as well as due to the modern function assigned to it, it is necessary to replace the existing wooden mezzanine structure with a new, steel structure, with the obliging construction of a new staircase made of modern materials: steel and glass, all according to the completed and accepted project and static calculations for all parts of the building that is subject to rehabilitation and reconstruction. The new steel structure consists of steel beams—pipes with a rectangular cross-section—which are oriented across the floors, i.e., perpendicular to the direction of extension on the adjacent floor (Figure 22).



**Figure 22.** Tower Motrilja. (a) New mezzanine construction. (b) Roof construction. (c) Detail of the mezzanine (Photo source: private archive of Vladan Vidosavljević).

The tower is founded on a solid base, in a rock of millions of years old clay slate, without a thorough expansion. It is planned to retain the appearance of the existing roof structure, with the original covering material—tiles, with the installation of thermal insulation within the roof layers.

Until the reconstruction, vertical communication between floors took place via a ladder due to the collapse of the original staircase. The construction of a new staircase made of steel and glass requires the construction of a new strip foundation—counter beams 50 cm wide (T3). The static calculation determined that the new stair foundations should be built over a layer of compacted concrete 8–10 cm thick. Next to the polygonal staircase, four columns with a diameter of  $\text{Ø}141.3 \times 6$  mm will be placed on each break, on which the central floor structure and the staircase structure rest.

Protection of the building from moisture should also be foreseen: vertical waterproofing of the outer side of the stone wall should be done on the floor slab of the basement floor.

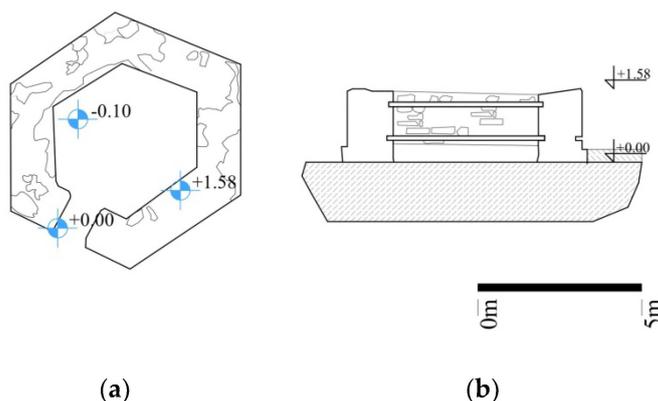
A non-invasive technique of rehabilitation and strengthening of all its parts was carried out on Tower Motrilja, whereby the concept of the building did not change during the rehabilitation interventions, the architectural appearance of the object remained authentic, and the investment costs were within the anticipated framework. In some segments, an invasive technique was applied: the work involved a completely new part of the building, a new staircase, from the foundation to the entire structure.

#### 6.4.2. Invasive Techniques on the Example of the Tower Dzephana

Some buildings have been partially or completely demolished over time, as a result of war and partly as a result of various natural disasters (earthquakes, floods, etc.), as is the case with the Tower Dzephana. Archaeological excavations carried out at the Fortress in 2020 revealed a hexagonal building of smaller dimensions at the base, next to the northern Tabia of the fortress (Figures 23 and 24). The tower must undergo an invasive structural restoration technique and rebuilding of its walls. Levels 1–3 of the proposed measures and costs can be found in Section 6.3.



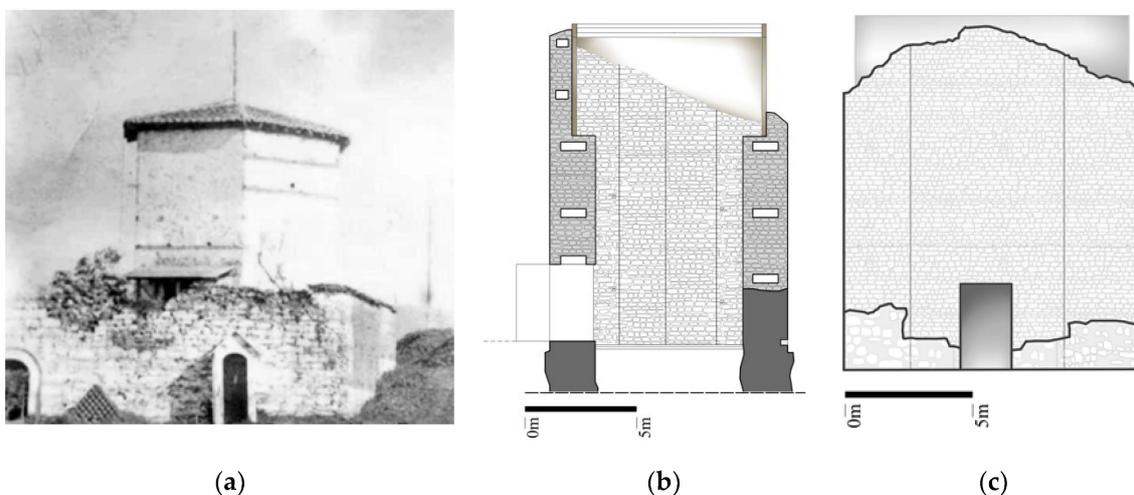
**Figure 23.** Archeological site of Tower Dzephana. (a) Aerial view. (b) Detail of the foundation (Photo source: private archive of Vladan Vidosavljević).



**Figure 24.** Drawings of the Tower Dzephana. (a) Base—foundation of the tower. (b) Cross—section of the tower (Drawings: Lejla Zećirović).

The experts of the Institute for the Protection of Cultural Monuments proposed measures and made the technical designs for the reconstruction of the Tower Dzephana (which are under consideration), based on the preserved data of archival material. The existing preserved remains of the tower are about 2 m high. Reconstruction in two phases is recommended. After the restoration and conservation of the original remains, the tower will be renovated and expanded with authentic materials (stone, wood) based on the existing structure. The reconstruction project of the Tower Dzephana is ongoing and proposals for its future appearance are being considered. The height of the masonry in authentic

material is about 9.0 m. One of the ideas is to build a wooden platform on the inside of the rampart walls from which the tower will be accessed and which will have the function of a viewpoint towards the city: towards the new and old part of the bazaar. It was suggested that the last rows, i.e., the crown of the tower, should be bricked unevenly, in order to leave the impression of damage, i.e., a ruined tower, the appearance of which is evidenced by photo documentation from the Second World War (Figure 24a). The building will have three floors, and the proposal is for the last floor to be made of glass. The Tower Dzephana will have a completely new, modern purpose, which justifies the proposal of using modern materials—glass and steel. The suggestion is that the bricking should be done in regular rows with broken stone with two faces and the core is filled with hewn stone. Horizontal wooden beams would be placed at certain distances. The second stage of the reconstruction would be the construction of a glass floor–lookout (Figure 25b,c). The construction of the platform and observation deck made of steel, with primary and secondary supporting profiles, according to the static calculation, was proposed. New mezzanine structures should ensure an even distribution of seismic impacts on the vertical elements of the structure. Three types of materials could be clearly distinguished on the building: the remains of the medieval tower made of original stone, reconstructed parts of the tower with uneven ends made of replacement stone, the most similar to the original, and glass on the final floor of the tower. It is necessary to make an assessment of the condition of the foundation and a calculation for the necessary reinforcements, because the foundation should accept both the existing and the additional vertical load, resulting from the mass of the upgraded part, but also from seismic influences. The combination of old and new materials, the contrast between the glass structure and the authentic “layer” of the medieval architecture of the fortress, creates the dynamics of the entire composition.



**Figure 25.** Tower Dzephana. (a) Tower Dzephana before the demolition, called Ahmed Aga’s tower (It is assumed that he rebuilt it) (Photo source: private archive of Vladan Vidosavljević). (b) Cross-section of the tower Dzephana—proposal. (c) Detail of the materialization of the façade—proposal (Drawings: Lejla Zećirović).

## 7. Space Activation

Keeping these buildings with vernacular architecture from disappearing is not only related to design values, but also to cultural and spiritual values. In the face of the onslaught of modern construction techniques and architectural styles brought by educated builders, buildings need to be renovated and strengthened so that they remain authentic, which is often very difficult to achieve. On the other hand, these objects should be “trained” for new functions, for modern demands of society, which includes their valorization. As clear as the concept of protection of cultural assets is, the concept of valorization is broad and does not always have the same meaning for everyone. Valorization of cultural heritage includes

its (re)activation. The term valorization includes a series of activities and strategies, each of which can be viewed from a different perspective and with differently set goals. In our country, the concept of valorization of cultural heritage is most often linked to economic valorization through integration into the tourism product. More simplified, the goal is to bring as many tourists as possible and most often to achieve direct or indirect economic profit. The area of the fortress can be used for organized meetings and exchange of ideas of young creative people (faculties, schools are in the immediate vicinity), a space for socializing, learning, thinking, entertainment, for creating, and finally, presenting what has been achieved. Potentially, it can also be a space for spectacles, for a public purpose accessible to all. The buildings inside the fortress should be kept at the level of preserved and partially restored parts, using modern methods in their presentation. In this way, the former appearance of the fortress would be preserved, and the complex would be revitalized and opened for tourist visits. The space, certainly in a positive way is completed today by the building of the city library “Dositej Obradović”, (Figure 26a) instead of the former cinema “Crvena zvezda” (adapted with the financial assistance of the Ministry of Culture of the Republic of Serbia, since 1996, permanently owned by the city). A stage for various events was recently built on the area of the western Tabia (Figure 26b). Around the stage, there is a space for visitors with fixed seating, with the possibility of expanding it for larger events such as the “Old Town” music festival, “World Music Fest Zeman”, “Amateur talents school festival”, and others.



**Figure 26.** Interventions at the city fortress: (a) City library in the area of the fortress (Photo source: Branko Slavković); (b) summer stage on western Tabia (Photo source: Lejla Zećirović).

In order to create the true ambience of the time in which the fortress was built, the idea is to pave the surrounding streets (Gradska and Svetosavska street) with cobblestones and, if necessary, to close them to vehicular traffic during events. The connections of today’s park (remains of the city fortress with Tower Motrilja) with the surroundings are accessible, the position and movement within the space correspond to the lines of natural movement of the users. The large level difference between the entrance and exit of the park is well overcome, which can be seen in the natural ramps and staircases that have become part of the habitat with their comfort and aesthetics. There are plans to grow the park into an open-air museum, which would increase the quality of the space even more. For the purpose of the recommended conversion of this area, the appropriate infrastructure should be built, which means the construction of new footpaths, parking spaces for tourists in the outer borders, information points, urban furniture, souvenir shops, a sanitary block for visitors and employees, and the like [9]. It is necessary to achieve a balance between conservation/improvement/use and strengthening and rehabilitation interventions on the buildings within the area of the fortress, improve the accessibility of this building, initiate some corrective activities (activate the project of organizing public events), apply design solutions, while animating the wider community for multi-year planning allocation of financial resources, with the aim of preserving this cultural heritage, suitable for public use, and promotion of the preservation of tradition in these areas.

Objects and places in themselves are not the only thing that is important for cultural heritage. They are important because of the meaning and uses that people attach to them, as well as the values they represent [56].

## 8. Conclusions

Cultural heritage promotes social identity and represents a tangible link to the past, connecting new generations to their common history. However, the structural behavior of historic buildings is often unsatisfactory, especially when exposed to loads caused by earthquakes, floods, and other hazards caused by nature or man, which greatly complicates their reuse and preservation.

One of the modern and innovative ways of preserving cultural heritage is its digital protection which consists of the processes aimed at ensuring the continued accessibility of digital materials. E-Europe creates conditions for cooperation and inclusion of all important monuments, sites and institutions in the digitalization process, which will help record history, establish a digital library for researchers and public education, and enrich cultural vibrancy. AI and other advanced technologies can help with the restoration and digitalization of tangible cultural heritage. The digitization procedure provides a “picture” of the cultural objects which helps to identify culture and create endlessly connected experiences for visitors, whether on-site or online. It is expected that these systems of digitalization of tangible and intangible heritage of the multicultural and diverse environment of Novi Pazar in Southern Serbia will become a part of the national information system for management and preservation of its historical treasure.

The monuments of the historical heritage of Novi Pazar and the wider area from the Turkish period were built as masonry, massive objects, without frames, made of stone as the basic building material and using lime mortar as binder. Observed from the aseismic aspect, the required authentic structural form, elements and construction techniques showed numerous deficiencies. The paper presents some intervention techniques as responses to the conservation and construction intervention criteria, with the aim of creating acceptable structural safety conditions for the historical building that is the subject of research. The presented intervention criteria are aimed at upgrading the existing structures, which in their actual condition do not have the ability to fully respond to the safe conditions of seismic and static loads.

The most common and important structural problems that need to be solved in the rehabilitation of the city fortress relate to damage due to ground subsidence or the effects of natural disasters in the past, which resulted in the collapse of parts of the building, the overturning its high parts and the tilting of the walls, which further causes the roofs and the floors to collapse. The restoration proposal is presented in the paper on the case study of the walls of the city fortress and Tower Motrilja (Watchtower) using a non-invasive technique, and an invasive technique in the case of Tower Dzephana. The concept of recovery of a damaged building includes a set of measures to establish its stability in the event of an earthquake, through rehabilitation and strengthening of foundations, walls, floors, roofs, connecting walls and floors, strengthening inter-floor constructions, replacing worn-out parts with new ones, etc. Strengthening of the walls is done by injecting and replacing worn-out plaster and stone, along with strengthening the walls by inserting reinforcement and pouring mortar over the reinforced structure. The replacement stone should be of the same type as the original or the closest possible equivalent. The paper presents various methods of protection, from those that require strict adherence to traditional crafts and techniques, to those that introduce new materials and structural systems. The choice between traditional and innovative techniques should be applied on a case-by-case basis. Preference should be given to the least invasive techniques and most compatible with heritage values, bearing in mind the requirements for safety and durability. The compatibility of materials is the most important prerequisite for obtaining good and lasting results, in order to preserve a unique cultural landscape for future generations, together with the natural environment. Bearing in mind that rehabilitation from the consequences of seismic activities on the city fortress

in Novi Pazar has not been shown in science so far, this work is surely expected to make a certain scientific contribution.

The authors suggest the need for better preservation of these buildings with the global issue of sustainability. It is necessary to define what constitutes a danger to heritage. Complete and detailed reconstruction is a long and financially demanding task. A high level of protection of historical heritage should be connected with the interests of the entire community of the given area, as well as all those who will invest in its revitalization and quality development.

Increasing social awareness of the importance and positive consequences of organized protection of cultural heritage is important not only for the sake of documenting our cultural, artistic, historical, and national values. This attempt to keep heritage alive in many ways contributes to the organized protection of tangible and intangible cultural assets, further sustainable development, its valorization and successful development of the economy and society as a whole.

Urban conservation and activation of the fortress area for mixed use, by organizing events that open new relationships with the city (open-air museum, library and various events) are important tasks for preserving this cultural heritage, suitable for public use and promoting vernacular architecture in these areas.

**Author Contributions:** Conceptualization and visualization, J.A.; each of the six authors, J.A., L.Z., D.D., B.S., J.S. and J.B. contributed equally to the collection of empirical material, research, and essential revision of the work; drawings and on-site photos: L.Z. and B.S. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** Many thanks to the Vladan Vidosavljević, the archaeologist of the Museum Ras in Novi Pazar, who provided us with material, photos, and documentation, as well as to Hivzo Gološ, archival advisor and historian, for constructive advice and guidelines for research.

**Conflicts of Interest:** The authors declare no conflict of interest.

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