

## Intervention strategies for rehabilitation of the architectural heritage in red saraya district

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### Abstract

Rehabilitation of the architectural heritages refers to the intervention of the structures that are implemented on historical and heritage structure in order to preserve their existing elements and utilize their spaces in a way that protects their historical and cultural values and convey them. In this article, Red Saraya/ Tripoli Castle in Tripoli is selected as case study in order to propose rehabilitation strategies for the historical buildings which suffered with damages. In the literature review, the current rehabilitation strategies and techniques are discussed. In the case study, the dangers and risks facing the rehabilitation plan are reviewed from different perspectives. In the conclusion, rehabilitation strategies for the Red Saraya / Tripoli Castle are discussed with five main objectives to preserve the structures; achieve a historical landmark, attract tourism, attract financial income, study and define the archeological eras that formed the existing structures.

**Keywords:** Rehabilitation; Intervention Strategies; Red Saraya; Tripoli; Libya.

استراتيجيات التدخل لإعادة تأهيل التراث المعماري في منطقة السرايا الحمراء

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الملخص:

يشير إعادة تأهيل التراث المعماري إلى التدخل الهيكلي الذي يتم تنفيذه على البناء التاريخي والتراثي من أجل الحفاظ على عناصره الحالية والاستفادة من مساحاتها بطريقة تحمي القيم التاريخية والثقافية وتنقلها. في هذا المقال، تم اختيار السرايا الحمراء / قلعة طرابلس في طرابلس لتصميم حالة دراسية،

من أجل اقتراح استراتيجيات إعادة تأهيل المباني التاريخية التي تعرضت لأضرار عبر الزمن. عند مراجعة الأدبيات السابقة، تمت مناقشة استراتيجيات وتقنيات إعادة التأهيل الحالية، ومن خلال الحالة الدراسية تم مراجعة الأخطار والمخاطر التي تواجه خطة إعادة التأهيل من زوايا مختلفة. في الختام، تمت مناقشة استراتيجيات إعادة تأهيل السرايا الحمراء / قلعة طرابلس من خلال خمسة أهداف رئيسية للحفاظ على الهياكل؛ المحافظة على المعلم التاريخي، والجذب السياحي، والحصول على الدخل المالي، ودراسة وتحديد العصور الأثرية التي شكلت الهياكل الحالية.

**الكلمات المفتاحية:** إعادة التأهيل؛ استراتيجيات التدخل؛ السرايا الحمراء طرابلس. ليبيا.

## **1. Introduction**

The significance of historic buildings emerges from their importance historically, culturally, socially, and environmentally. Therefore, any strategy that aims to rehabilitate a historic structure shall first raise awareness to these aspects, followed by maintaining the remaining structure, strengthening it, and then apply finishing and decoration works to it in an aligned manner with its historic and present contexts [1]. Moreover, any rehabilitation works that are performed on historic structures has to follow certain guidelines that ensure that the rehabilitation and the intended future function preserves its value, while enabling the people to use it in a beneficial way that let them appreciate its historic value [2]. Thus, the governments in developed countries have issued generic and specific guidelines in order to ensure that any rehabilitation of the architectural heritage is conducted in a way that establishes the connection between the community and the historic structure [3].

There are certain concepts that need to be taken into consideration when rehabilitating a building, which includes analyzing the needs of the current community, defining the constraints that are imposed by the existing structure, recovering the building to the best state possible, and providing an alternative design that satisfies the preservation objectives and the refunctioning purpose [1]. Therefore, the refunctioning of the building, also known as adaptive reuse, is basically a strategy to preserve the historic building, giving it a new context that keeps its value and allows the local community to use it in a beneficial manner [4].

Furthermore, there are specific challenges that face architects and developers when planning and performing rehabilitation including

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compliance with preservation laws and building codes and implementing modern utilities provisions into buildings that are not designed to have them. Moreover, structural issues maybe faced as the building may not be ready to receive loads that are associated with the new rehabilitation plan [5]. In this article, the Tripoli castle is chosen as the case study due to its historical importance to the capital of Libya. The castle includes several structures that were built during different time periods extending to the Phoenician civilization.

The major problem on the rehabilitation process of the Tripoli Castle is the lack of architectural and archeological studies that attempted to rehabilitate the castle structures and refunction them with a strategy that establishes the connection between it and the local community. Moreover, there are no national codes or guidelines for rehabilitation, adaptive reuse or refunctioning of historic structures in Libya. Therefore, this article is an attempt to study the challenges that are faced during the rehabilitation of the historic buildings in Libya, in addition to setting a strategy that allows the preservation of the castle archeological structure, while allowing the local community to use it to promote the history and culture of the city.

The study encourages the preservation and rehabilitation of historical buildings and landmarks in Red Saraya. The importance of this study is apparent in its distinction of being one of the few studies that address the rehabilitation of the Red Castle and the historic traditional buildings of Tripoli and their maintenance.

Red Saraya and the historic buildings are considered one of the most important landmarks in Tripoli that still exist, reflect the old civilizations of Roman, Knights of Yohna, Ottoman, Italian and crusaders that have lived in Libya. The history of its civilization and its importance to the present times has made it hub for many who are interested in archaeology and the Libyan heritage. Subsequently, it must be revived and rehabilitated according to various strategies and findings, as a continuation of the presence of the heritage of Libya. The Red Saraya and its historic traditional buildings are, likewise, material examples of the culture of past and present societies, which reflect and demonstrate human endeavors and their capability to improve the quality of life and promote understanding of self-reliance and societal values. At the same time, this research increase opportunity for social and economic

development through challenging situations as what Libya is going through.

## **2. Literature Review**

Rehabilitation of historical buildings is a practice that has been adopted since fourteenth century, which was first performed to the ancient city of Rome in Italy. However, early trails for preserving archaeological structures can be traced back to Egypt 3000 BC, where parts of Ramses II's statue was endangered and therefore supported using stone blocks. In the fifteenth century, the concept of restoration and rehabilitation developed in Italy in order to preserve buildings, statues, sculptures and monuments from the Roman era. The restoration works continued during the following centuries to restore several monuments that were of great historical, architectural and archaeological value. In the Seventeenth century, the concept had spread to England then France, which led to new theories and concepts to emerge [6].

During the twentieth century, countries started to develop guidelines for restoration and rehabilitation works in order to ensure that the essence of the historical structure and artwork is conveyed and not abolished by the new works [6]. Stanley-Price (2009) defined the difference between reconstruction and restoration by the addition of any new elements to a place. If the process of returning the place to its early state involves adding new material to the fabric, then it is categorized as reconstruction. Moreover, the need for reconstruction is decided through a case-by-case evaluation, where supporters of the concept is justified through the symbolic value of the structure for the national heritage, the need to re-use the buildings, educational and research purposes, promoting tourism in the country, and protecting historical sites from development that could damage the historical value of the structures. Nonetheless, reconstruction principles are objected against through the arguments that reconstruction hurts the evocative value of the buildings and impossible to achieve the authenticity preserved within the ruins. Furthermore, reconstruction and restoration works may lead to the destruction of original evidence and disrupt the landscape value of the site [7].

The restoration and rehabilitation processes commenced through performing a comprehensive assessment of the structure, which should include several approaches. It is important that non-destructive testing and analysis is performed in order to ensure none of the available ruins are damaged. The analysis process starts by identifying the elements

from different time periods and surveying for any hidden structural elements. Thereafter, the building process and techniques shall be identified and the structural performance of is evaluated. Damages and defects are identified and classified, along with any previous maintenance that has been performed on each element [8]. During the restoration process of the archaeological ruins, there are three main types of challenges that are faced [8]:

1. Physical condition of the element.
2. Availability of resources for the rehabilitation process.
3. Cultural and social importance of the restored element.

Based on that and the guidelines of the American standards for restoration of historic and archaeological elements, Sandbhor & Botre (2013) developed a systematic approach for the restoration and rehabilitation process. The process starts with the required analysis to understand the condition of the restored element. Following a thorough evaluation, the variation between the current conditions and the original conditions are identified in order to understand the gap between them. Furthermore, the treatment strategy is chosen according to the results of the analysis; restoration, reproduction or reconstruction. Some elements may need to be completely replaced, while others can be kept for certain types of maintenance. One of the most important concepts in the treatment strategies is to ensure that elements are protected against the conditions that caused its deterioration [8].

Pinto et al. (2017) provided specific assessment criteria that need to be implemented in order to ensure that the historical building is rehabilitated and refunctioned according to the user requirements. The authors divided the refunctioning plan into four main stages:

1. determining the requirements and needs of the users.
2. definition of constraints including the historical and artistic factors.
3. designing the recovery solution.
4. evaluating the recovery solution.

The criteria that are used to evaluate the building and design proposed for the refunctioning are categorized into environmental and technological systems. The environmental system is assessed based on aesthetic features, such as space visibility and element recognition, usability features, such as elements flexibility and space adaptability, and

manageability features, such as elements reversibility. The technological systems are evaluated based on safety features, such as stability, fire safety and user safety, comfort features, such as thermal, acoustic and visual qualities, and usability features, such as elements adaptability and adaptability of surface finishing and mechanical systems. The weights of the criteria as determined by the authors are presented in Table 1 below.

Table 1: Criteria used to evaluate the refunctioning strategy of archaeological structures [1]

	<b>Criteria</b>	<b>Sub-criteria</b>	<b>Weight</b>
Environmental System	Aesthetics	Space visibility	0.135
		Element recognition ability	0.090
	Usability	Elements flexibility	0.090
		Space adaptability	0.135
	Manageability	Elements reversibility	0.150
Technological System	Safety	Stability	0.038
		Fire safety	0.038
		User safety	0.038
	Comfort	Thermal quality	0.003
		Acoustic quality	0.006
		Visual quality	0.010
	Usability	Element adaptability	0.025
		Surface finishing and mechanical systems	0.051

A Chinese case study identified the benefits of refunctioning and adaptive reuse of historical buildings under different categories. Achieving economic sustainability is one of the most important benefits, which are indicated through the increase of land value and enhancement of economic efficiency. Furthermore, social benefits are expected from historical buildings' refunctioning as it enriches the sense of place, increases social interaction, conserves the social heritage of the city, and improves the life quality and living environment. Political and institutional benefits are also part of the adaptive reuse outcomes as it gives the opportunity for society members to participate in their heritage and simulates the government to issue compatible policies [9].

Ragheb et al. (2017) concluded with eight main principles that shall be considered during the refunctioning process of historical buildings. The first principle is to analyze and understand the importance of the building that is used for refunctioning. Subsequently, the new function of the building shall be aligned with its historical, political, cultural and social

significance. The refunctioning plan shall adopt material and methods that can be reversible and does not impose any damages to the historic fabric, promote minimum intervention, promote maximum retention of historic fabric, and conserving the position of the historic building in the archaeological context. Furthermore, the adaptive reuse plan shall include a management strategy that could monitor the condition of the original historic fabric in periodical manner and maintain the visibility of the historical value of the structure [4].

### 3. Aim and Method

Tripoli Castle and other historic buildings have suffered with several structural and cultural damages among which, some of them were natural and other tend to be human made. The rehabilitation strategies will allow the city to restore and preserve the traditional landmarks and houses in Tripoli. Furthermore, it will replenish the traditional local architecture and illuminate the Libyan identity and character that is important in the study and analysis of the architectural factors of these buildings to improvise their compatibility with their present urban architectural surroundings. From this perspective, this article aims to state the problems of the rehabilitation process of these houses as they have been prone to various misuses and negligence regarding restoration efforts. The main aim of the study is to analyze the rehabilitation process of the structures in Tripoli castle in Red Saraya district in order to improve the cultural heritage buildings from further damages and efforts to enhance the appearance for long period of time. The findings of the research shall benefit professionals of rehabilitation in Libya through identifying the issues, damages, and challenges that are facing the historic structures in Tripoli castle. Moreover, the suggestions and intervention strategies provide a solid starting point for rehabilitation works. It is also expected for the findings of this research to benefit the city through attracting more tourism and economic activities as a result of a better aesthetic and historic value. Subsequently, this should encourage authorities to pay more attention to historic and archeological inherits in Tripoli, which strengthen the national identity of the city and Libya in general. The intervention strategies and suggestions provided in this research are mainly meant to be utilized by public and private architecture professionals as a stepping stone for rehabilitation projects.

This study is limited to the Red Saraya district which is mainly located within the premises of Tripoli Castle. From the sea, Saraya comes across directly and not separated by roads like the rest of the city. It is surrounded by a city wall whose thickness is not less than the walls of the fortification. However, many governors have done restoration work on this castle in the past, which contributed extensively to restoring its structure, but a limited part of the structure has survived to the current days. The study includes also a theoretical review of the strategies and considerations that have to be applied for the rehabilitation of the historic buildings. Thus, it is significant to include previous case studies that applied these strategies to different cases around the world in order to understand the challenges and the effective measures that were taken to ensure the success of these projects.

The main aim of the rehabilitation process is to produce a compatible use for a structure by addressing the damages that occurred to it, which includes reinforcing, repairing and preserving parts of it, each according to its need, without affecting the archeological and historical values that are conveyed through it. The need for rehabilitation emerges from the need to enhance the existing buildings and alter them in a way that can be utilized for current use purposes. Moreover, rehabilitation methods are great means that conserves the archeological and architectural values of structures. Due to weathering and aging conditions, buildings develop a condition that cannot allow usage according to the initial intent of their design. Even relatively new buildings may be in conditions that need further enhancement in order to be used in current times. There is a continuous motivation in developed countries to maintain existing buildings in order to preserve the architectural and archeological heritage of the local communities.

Since the majority of archeological structures were built in eras where technological advances were humble, the rehabilitation process includes adopting the structures to the current technologies, which means adding modern electrical, water, drainage and communication utilities. Rehabilitation processes are described as sustainable development practices, which require an extensive effort on the governmental and social levels in order to raise awareness to their importance. The structural safety of heritage buildings is one of the most crucial challenges for rehabilitation, which is also one of the most complex procedures to be performed due to the complex procedures. The materials that form heritage buildings are of archeological value that does not allow extensive destructive testing or

the addition of new material. Thus, intervention methods and materials have to be monitored in order to ensure that the structure does not lose its value.

There is a range of intervention methods that are used to rehabilitate heritage buildings, where the simple form is to perform limited maintenance on limited areas of the structure. A more complex intervention would aim to increase the structural and service performance of the structure. In order to be able to construct a rehabilitation plan for the structures within the Tripoli Castle, it is critical to comprehend the architectural concepts that they were based on in the past. Furthermore, understanding the challenges and destruction sources that caused the deteriorations is important to prevent any future damage to the structure. After all information is gathered, a comprehensive rehabilitation plan can be designed for that purpose.

#### **4. Analysis**

##### ***4.1 Dangers facing the historical buildings in Tripoli***

The risks and dangers that are associated with the rehabilitation process of the Tripoli Castle is divided into two main categories; risks and dangers associated with the structure and risks and dangers associated with the process. The structure of the Red Saraya faces many challenges including structural and non-structural cracks, lack of maintenance, war status in Libya and motivations for government interest. Moreover, the challenges associated with the rehabilitation process include material originality and endurance, threats to the historic and cultural values, structure misuse, and implementation of modern services.

The identification of these challenges of risks is inspired by the structure status and the risk management plan and process suggested in the literature [10]. However, the focus in this study are for immediate risks that are hindering the adoption of a maintenance, rehabilitation plan based on the judgement of the researcher.

##### ***4.1.1 Risks related to the structure and the government***

- Structural and non-structural cracks

Through a survey of the structure of the Red Saraya, several cracks have been observed that jeopardize the structural integrity of the buildings and the aesthetic value of the surfaces. The main classification of cracks in any structure categorizes them into structural and non-structural cracks,

where structural cracks are found in structural elements like columns, beams and slabs due to flexure, shear, torsional, corrosion. The structural cracks result from extra load on the main structure that causes its failure [11]. Furthermore, there are other cracks that are caused by local stresses within the building material, which do not weaken the structure, called non-structural cracks. The cracks within structures has several causes varying from moisture content changes, thermal changes, deformations, creeps, chemical erosion, foundation settlement and growth of vegetation [12].

There are several cracks that are observed within the different buildings in Red Saraya. Figure 1 shows a structural crack within the stair slab from the bottom side and the width of the Crack exceeds 10 millimeters. The presented crack example has several consecutive cracks that are close to each other, which require an extensive treatment and strengthening. The ancient wall shown as the back surface of the stair was rehabilitated in an earlier period; however, several cracks can be observed that require assessment and treatment. Figures 2 show other examples of cracks within the walls and slabs of Red Saraya in Tripoli Castle.



Figure 1: Structural and unknown cracks in a stair and backwall at Red Saraya



Figure 2: Deep cracks in the walls and slabs of Red Saraya

- Lack of Maintenance

The maintenance performed to the structure of the Red Saraya was not extensive, as it addressed some of the main structures within the castle, while ignoring other parts. Despite the time passed since the last maintenance performed, some of the structure is still keeping the same acceptable condition. Nonetheless, these areas require minimal intervention in order to inspect the surfaces and repair the painting and any broken elements. Figure 3(a) shows the rehabilitated parts of the castle, while Figure 4(b) shows some parts that have been ignored in the last rehabilitation plan.

*Intervention strategies for rehabilitation of the architectural heritage in red saraya district*



(a)



(b)

Figure 3: (a) Parts of the Red Saraya that received rehabilitation measures and requires minimal repair and intervention (b) Parts of the Tripoli Castle that were not included in the rehabilitation plan before and requires further intervention

It is apparent from the condition of the different parts of the structure that no clear and periodical maintenance plan is in place, as some parts were addressed, and others were ignored. Moreover, it can be observed that modern services have been added to the ignored parts and used as offices or gallery halls from the other side. Thus, the maintenance plan shall include all the parts of the castle, while ensuring that parts from different eras are identified and presented.

- War Status in Libya

After the revolution in Libya in February 2012, the political and military control of the city has been unstable since then. Several historical and archeological structures have been affected as they were used by rebels and militias. Moreover, the Red Saraya structures have been impacted by the war status in the country, where some of them were demolished or

damaged. Figure 5 shows a courtyard in Saraya before and after a war attack on it with rockets.



Figure 5: A courtyard in the Saraya before and after a war attack

- Motivations for government interest

The governmental interest in rehabilitating the buildings within the Tripoli Castle is another risk that affects any rehabilitation plans. The heritage authority has the custody over the structures; however, there is no serious consideration for the current condition of the buildings as they are under constant threat by political and security instabilities. Furthermore, the lack of budgets and technological capabilities are crucial obstacles for maintenance and rehabilitation. As the heritage administration is left alone to manage the structure, none of the other governmental bodies are interested in initiating any attempts to preserve the historical and archeological structures. The country is also suffering from the lack of necessary legislation that monitors the protection of heritage structures.

The abovementioned factors resulted in the lack of structural and architectural testing and assessments for the structures within the castle, jeopardizing the possibility to sustain the historical and cultural values

undamaged. There are no trials from the government to initiate plans or implement them towards the rehabilitation, preservation, or maintenance of the Saraya buildings, which is illustrated in the weak management infrastructure, reporting systems and security plans [13]. As some citizens own parts of the Saraya, the coordination between them and the government is another challenge that prevents the implementation of rehabilitations.

#### 4.1.2 Risks related to the process

- Material originality and performance

In historical building rehabilitation, the plan shall ensure that the finishing material for surfaces matches in color, texture and properties those of the original structure. Buildings that are originally finished with stone and clay can be matched with raw material from the surrounding environment that was used to build the historical structure. Nevertheless, in order to increase the integrity of the structure new material resulting from technological advances can be used in invisible areas. Structural and non-structural cracks can be filled with epoxy or polyurethane, which can prevent the passage of any leaking chemicals from the cracks and maintain the needed structural strength [14].

Furthermore, columns with exposure to water can be wrapped with waterproofing chemicals, such as EPDM and polymers, and then finished with material matching those of the original structure [15]. Moreover, the most common material that are used to treat issues like peeling is Mughal plaster, which has a lime base. Other issues like mold stains can be washed with high pressure water with soap and vegetation can be resolved by applying Glyphosate, Ammonia and lime mortar [14]. The material used in the Red Saraya is mainly lime mortar covering limestone structures. Some of the more recent buildings are constructed from clay and wooden material. Further solutions are narrated in the rehabilitation procedure in the third section of the analysis.

- Threats to historic and cultural values

When assessing a heritage structure for rehabilitation, it is important to understand its historical and cultural significance, which shall be balanced with the social, touristic and economic outcomes of the

rehabilitation plan [16]. The main aim of the assessment and plan should be the conveyance of the historical and cultural essence of the heritage structure while enabling the society to benefit from it through investment in the touristic domain. A spatial analysis shall be performed in order to understand the urban morphology of the targeted structure within its surroundings. Such an analysis enables designers and planners to incorporate the local rehabilitation plan into a global one for the civilization area around it [17]. For the Red Saraya, Figure 6 shows the morphology of Tripoli around the castle, which includes several historical monuments, including the seaport and the old city of Tripoli. The rehabilitation shall represent the castle as the center of attention and the ruling courts of the city. This can be easily shown due to the high walls of the Castle and its location on the coast. The connection between the old city and the Saraya shall be seamless but distinguished in design elements. Therefore, developing a global rehabilitation plan for the old city is one of the challenges that may face any specific local plans for the Tripoli Castle.



Figure 6: Tripoli areas surrounding the Red Saraya

- Structure misuse and implementation of modern services

It is possible to find some misused buildings or parts within the targeted heritage structure, which mainly are the result of ignorance of the governmental bodies and NGO's. In the Red Saraya, misuse is observed in a few parts, where buildings have been used for offices and storage

spaces without paying attention to their historical and cultural value. Figures 7 and 8 show some examples of misuse, as modern utilities have been added and structure has been ignored, leading into the deterioration of the structures' conditions. Moreover, some areas have witnessed the addition of inappropriate finishing material that does not match the original material used.



Figure 7: A building in Tripoli Castle where modern utilities have been added without a clear rehabilitation plan, ruining its historical and cultural values



Figure 8: A house in Tripoli castle with the addition of inappropriate material and utilities

As discussed in the previous section, the historical and cultural values shall be conveyed with the rehabilitation of architectural heritage. In the Red Saraya case, buildings have been rehabilitated in a limited manner for the heritage purposes, where museums are located. The remaining buildings are used for administrative purposes, which led to the loose of using them into the overall refunctioning to convey the historical significance of the structure.

#### ***4.2 Rehabilitation levels of historic buildings in Tripoli***

The plan developed for rehabilitation for the buildings of Red Saraya and the old city of Tripoli globally shall be encountered on different levels using certified methods. Furthermore, the methods and plans shall be specific to the historical and cultural needs of the city according to its historical and geographical considerations. There are several styles for rehabilitation according to the purpose and understanding of the process objectives. For instance, Italians tend to be stringent during the implementation of rehabilitation methods, while Americans allow modern and innovative solutions to be used in the process. Unfortunately, no clear direction in rehabilitation style has been adopted in the Arab world, including Libya, where the architects determine the objectives

based on the client's needs and desired outcomes. The size and building type are the most important determinants of the levels of rehabilitation, as well as the historical and cultural significance of the building to be preserved. Therefore, the levels of rehabilitation can be classified as the following:

- Rehabilitation of the architectural heritage: ensuring the safety of archeological elements using scientific methods through restoration and treatment.
- Refunctioning of the architectural heritage: a level that aims to convert the historical buildings into museums or touristic destinations following the restoration and treatment.
- Rehabilitation by local authorities: designing the rehabilitation plan in a way that integrates with other conserved parts of the structure.
- International level rehabilitation: developing rehabilitation models for a specific case while sharing it with international organizations that are concerned with the domain, such as UNESCO.

In the Red Saraya case, a conservative approach can be followed for the most ancient structures, while parts of the recent structures can adapt the innovative additions. Areas for tourists can be used as cafes, gift shops, ticket offices. Any developed plans can be shared with UNESCO in order to ensure its conformity with international standards, while experts from the organizations can be employed for consultancy and advice.

#### ***4.3 Plans and procedures for rehabilitation***

A comprehensive plan shall be constructed with the cooperation of all concerned governmental, private sector and NGO entities in order to ensure the success of any rehabilitation plan. The objectives of the rehabilitation plan of the Red Saraya as part of the general rehabilitation plan of the old city of Tripoli shall be well defined and clear in order to attract the interested parties and facilitate smooth communication channels between the different entities participating in it. Based on the study performed on the case study and the process identified in the course of this research, the suggested objectives for the rehabilitation plan of the Red Saraya/ Tripoli Castle are:

- Preserve the archeological and historical heritage of the existing structures, as a social and national commitment for the next generations of the country.
- Achieve historical objectives from the preserved structures and monuments as part of registering the historical area in Tripoli, and specifically the Red Saraya, as a UNESCO certified site.
- Attract touristic traffic to city as one of the essential income sources for the city, which can be used for further development of the site.
- Achieve economic and financial incomes that can be used for the development of other historical sites in the city and the country.
- Define the historical eras that contributed to the existing structures of the Red Saraya, which shows the variety of civilizations and historical events.
- Use strict rehabilitation strategies in the preservation of the existing structures, while allowing innovative and modern ideas to be used in accordance with international standards.

Subsequently, the guidelines for implementing the rehabilitation plan of the Red Saraya, are as follows:

- Designate an initial budget that can be used to rehabilitate the first phase from the global plan, guaranteeing further income is generated gradually to fund the remaining phases. A national tax system can be used in order to collect the initial budget.
- Motivate private investors to invest in the rehabilitation plan by providing them with touristic and cultural investment plans.
- The rehabilitation plan shall be based on minimal intervention that preserves the historic and cultural values of the existing structures, with strict international practices and methods. A summary of rehabilitation methods is provided in Table 2, addressing the different methods according to their costs, durability and adaptability.
- Original structures and sites shall be protected against any theft or aggression, while rehabilitation processes shall not impose any damage to the archeological fabric on site.
- A historic timeframe shall be created for the different structures within the Red Saraya, with detailed descriptions, which can be documented and presented through the touristic tours in different languages.

- Innovative and modern features and utilities shall be added to the site with extreme care in order not to disturb the historical context, while services shall not be apparent or vocal.
- Priority shall be given to repair processes over replacement in order to preserve as much as possible of the original fabric and structure.
- Visible material shall strictly match the original material intended for the site, while modern technology material can be allowed for strengthening and increasing the performance of the structure while remaining not visible.
- Rehabilitation plans of other surrounding sites shall be fully coordinated with the measures taken within the Red Saraya.

Table 2: Rehabilitation methods and solutions for problems in historical structures [14]

Issue	Solution	Decision Parameters		
		Cost	Durability	Adaptability
Crack	Polyurethane	H	L	E
	Epoxy	H	H	D
	Stitches	L	L	D
Roof Leakage	Sealant and tile replacement	M	M	LD
	Asbestos and refill sealant	L	L	E
	Lead flashing	H	H	D
Peeling at wall or ceiling	Mughal plaster	M	H	M
Mold stain	High pressure water with soap	M	H	LD

**LEGEND**

H= High      M= Medium/ Moderate      L= Low  
 E= Easy      LD= Light Difficult      D= Difficult

Furthermore, the basic procedures of rehabilitation are identified in order to enable designers and contractors to apply the plan and guidelines

within the expectation and in accordance with international standards used for similar structures. Therefore, the following points summarized the procedures that can be used in each process for the Red Saraya rehabilitation strategies:

- Priority for any process shall always be given to identifying the historical value of the element, retaining, and preserving in accordance with international standards and methods.
- According to priority and significance, each of the elements of the historical structure shall be protected against damage and well maintained against weather conditions and human misuse.
- During the repairing of the elements of the historical structure each material shall be repaired in accordance with the recommended procedures with the minimum possible intervention. Repair is defined as treating a part of the element without compromising the overall value of the element.
- Replacement of elements shall be only in the case of the impossibility of using the original element. The original element shall be replaced with matching ones in terms of material and aesthetics.
- Missing historic features can be added according to need as seen suitable by the designer and as recommended by international guidelines. Options shall be provided, where the most matching option that conveys the historical value and context should be adopted.
- Alteration of the historical context can be performed as necessary in low profile areas with minimal historical value, such as parking spaces, retail spaces and administrative offices.

## **5. Discussion**

The case study of the Red Saraya shows two different types of dangers and risks associated with the rehabilitation plan; risks associated with the structure and the government, and risks associated with the process. In the structure, several structural and non-structural cracks were observed, which are essential to be resolved prior to any further rehabilitation works. It is evident that the lack of maintenance and maintenance plans and strategies in the past contributed into worsening the condition of the structure, in addition to the current war status in Libya that directly

affected parts of the structure with damages. In the past and in current times, the lack of interest of the Libyan government to implement an implementation plan with international standards added to the issues facing the Red Saraya.

In a rehabilitation plan, maintaining the original aesthetic and historic material is essential for the process, while current material that is developed to enhance structural performance can be used in invisible manner. Great attention should be paid to not impose any threats to the historic and cultural values that are conveyed and shall be conveyed by the heritage structure. In the case of the Red Saraya, several misuse practices were observed by implementing modern service and inadequate finishes to the historical buildings. Such practices shall be reversed and returned to the best matching condition of the original structure. Moreover, any rehabilitation plans shall be based on four main levels: element rehabilitation, element refunctioning, local rehabilitation, and international rehabilitation.

Furthermore, a plan and procedures for rehabilitation in the Red Saraya in Tripoli Castle were provided. Firstly, the objectives of the plan were identified to preserve the existing structure, achieve historical objectives, attract tourism, achieve economic and financial incomes, define and study the historical eras that formed the Saraya, and use strict methods for the process. The plan presented stressed developing a financial system that contributes to the budgeting for the project, which includes encouraging investments from different sectors. It was also instructed that all archaeological and historical elements within the Castle be protected, through security and documentation.

## **6. Conclusion**

The main aim of this article is to analyze the rehabilitation process of the structures in Tripoli castle in Red-Saraya district in order to improve the cultural heritage buildings from further damages and efforts to enhance the appearance for long period of time. Furthermore, the study aims to propose strategies that allow the preservation of the structure through empowering the social, historic, and cultural values of the city of Tripoli. A literature study was performed in order to understand the historical and archaeological values of the case study, which is the Red Saraya in Tripoli Castle, Tripoli, Libya. Since the Phoenicians understood the

importance of the city location, several military bases and cities were constructed to reinforce their position in the Mediterranean. The current structure of the castle provides archaeological evidence that the first castle with many remaining elements. The city developed during the roman, Islamic, Spanish and Ottoman rules, where the castle was the center of this development. The structures within the Tripoli Castle were constructed mainly during the Spanish rule and the second Ottoman rule of the city by the Karamanli family.

Based on the research outcomes, the researcher provides the following recommendations:

- The research outcomes show different guidelines and processes that could be used in the rehabilitation procedures, where priority is given to identifying and preserving the historical elements.
- Repairs are recommended over replacements in order to preserve the maximum possible parts of the Red Saraya and its historical and cultural value.
- In future research, a comprehensive design based on archaeological survey of the Saraya can be carried out using the provided plan and procedures described in this study.
- Future research could include parts, if not all of the Saraya, with the aim of preserving and utilize the great values behind the Tripoli Castle.

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