Evaluation of Historic Buildings Reparation in Tripoli, Libya

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Abstract
Historic buildings are old buildings have cultural value and regarded as a national heritage for the countries and should therefore be conserved. Historic buildings are existing buildings and the most important issue in their conservation is deciding the level of intervention in them. Intervention in historic buildings without guiding by conservation principles presents a problem against these buildings. The objectives of this paper are: to observe the interventions in a group of Libyan historic buildings, evaluate the extent of compliance with architectural conservation principles and, sheds a light on the main reasons those led to the contradiction with these principles. The research demonstrated that about 40% of observed works comply with architectural conservation principles. The main contradictions occur mainly in exaggerated intervention, using non-reversible materials and insensitive repairing. The main reasons those led to contradiction with conservation principles in observed historic buildings are lack of knowledge and lack of proper materials in addition to security and safety reasons. Observing current and previous repair works is a significant source of knowledge in terms of lessons learnt from successful and non-successful experiences. These lessons should pass into future repair works that will be achieved in historic buildings to avoid repetition of mistakes.
Keywords: Historic buildings, Repair, Conservation principles, Tripoli, Libya.

Libya'nın Trablus Kentindeki Tarihi Binaların Onarımının Değerlendirilmesi

Özet
Tarihi binalar, kültürel, değere sahip, ülkeler tarafından ulusal miras olarak kabul edilen eski binalar olduğundan korunması gerkir. Mevcut tarihi yapıları koruma konusundaki en önemli husus, müdahale seviyesini belirlemektir. Koruma ilkelerine uymadan tarihi yapılara müdahale etmek sorun teşkil etmektedir. Bu araştırmanın hedefleri, Libya'da bulunan bir grup tarihi binalardaki müdahaleleri gözlemlemek, mimari koruma ilkelerine uyumu değerlendirmek ve bu ilkelerle çelişen başlıca nedenleri aytınlatmaktır. Araştırma, gözlemlnen çalışmaların yaklaşık % 40'ının mimari koruma ilkelerine uygun olduğunu ortaya koydu. Başlıca çelişkiler, çoğunlukla, abartılı müdahale, geri dönüşümsüz malzemeler ve hassas olmayan olarak ortaya çıkmaktadır. Gözlemlenen tarihi binalarda koruma ilkeleri ile çelişmesinde temel nedenler, güvenlik eksikliği ve güvenlik nedenlerinin yanı sıra bilgi eksikliği ve uygun malzemelerin olmamasıdır. Mevcut ve önceki onarım işlerini gözlemleme, başarılı ve başarısız deneyimlerden alınan dersler açısından önemli bir bilgi kaynağıdır. Bu dersler, tarihi binalarla kazanılacak hataların tekrarlanmasını önlemek için yapılacak
onarım çalışmalarında dikkate alınmalıdır.
Anahtar Kelimeler: Tarihi yapılar, Onarım, Korunma ilkeleri, Trablus, Libya.

1. Introduction

Historic buildings (HBs) are old buildings have architectural, historical, economic, environmental and social values. They are regarded as a national heritage for the countries and should therefore be conserved. They are existing old buildings and the most important issue in their conservation is deciding the level of intervention in them. The levels of the conservation intervention include preservation, rehabilitation, restoration, reconstruction or a combination of these actions. Many conservation principles were issued to guide the conservers in the right way to intervene and conserve these buildings. However, intervention in HBs without guiding by conservation principles presents a problem against them. This paper explores the nature of Libyan historic buildings repair in order to evaluate the extent of compliance with architectural conservation principles.Also, it sheds a light on the main reasons those lead to contradiction with these principles in observed historic buildings.

2. The Levels of Intervention and Conservation Principles

The intervention in Historic buildings (HBs) means any action which has a physical effect on the fabric of buildings (BS7913, 1998), in order to extent their live. However, according to Feilden (2004), the intervention could be one of these actions: prevention of deterioration, preservation of existing state, consolidation of the fabric (cause something to make it stronger), restoration (returning HB to a known earlier state), rehabilitation, reproduction and reconstruction.

For guiding the intervention in HBs many conservation principles were issued. The Burra Charter advocates a cautious approach to change, in that we should “do as much as necessary to care for the place and to make it useable, but otherwise change it as little as possible so that its cultural significance is retained” (ICOMOS, 1999). Historic buildings conservation principles include things to be considered during the processes of repair and maintenance, specifically the methods and materials.

A number of authors; Brereton, 1991; Dannet all, 1999; Dann and Wood, 2004; Feilden, 2004; English Heritage, 2004; Hume, (2007) have emphasized that any intervention must be the minimum necessary and historic evidence must not be damaged, falsified or removed. Furthermore, regarding minimum intervention, HBs should be conserved as found (Hume, 2007) and repair above restoration or replacement Dann et al (1999). Moreover, honesty and authenticity (Dann et al, 1999) and like-for-like repairs are preferred (Dann and Wood, 2004; Hume, 2007). Finally, repairs should be reversible and sensitive (Dann et al, 1999; Hume, 2007).

Regarding the techniques and materials of conservation, ICOMOS (1999), CEC (2000), and Sweetser (2002) agree regarding the use of traditional (original) techniques and materials for conserving HBs, whereas appropriate modern (alternative) techniques and materials can be used when the original cannot be used. For instance, (ICOMOS, 1999: 3) stated that:

> “Traditional techniques and materials are preferred for the conservation of significant fabric. In some circumstances modern techniques and materials which offer substantial conservation benefits may be appropriate”.

Furthermore, Brereton (1991) and Lazarus (2007) call for the adoption of proven techniques, either traditional or innovative. For instance, (Lazarus, 2007: 327) stated that:

> "Both conventional and innovative conservation techniques should be considered. The latter may provide more cost effective means of protecting buildings than those that are more familiar, and they may be able to solve problems that in previous centuries did not have a sympathetic solution. However, where they are not yet fully proven it is unlikely that they will be immediately adopted for historic buildings, but worth developing further with that intention in mind."

Regarding affected materials in HB, Designation (2003) and Dann et al (1999) call for the repair of these materials rather than their removal or replacement (minimal intervention). For instance, Designation (2003) stated "Historic building materials, even if in a deteriorated condition, contribute to a building's character. Repairing this material rather than removing or replacing it, is an important conservation goal." However, where replacement is necessary, Dann and Wood (2004) and Hume (2007) suggest the use of like-for-like materials. Also, Brereton (1991), Designation (2003) and Dann and Wood (2004) suggest the need for truth in the use of materials in terms of the new work being distinct from the old, with no attempt to disguise or artificially age the work. For instance, Designation (2003) stated that "Where replacement is necessary, new material should be compatible with historic material in appearance, texture, colour and form, yet be distinguishable from historic fabric".

Moreover, Designation (2003), Smith (2010), Lazarus (2007) and others emphasize that the repair materials that are used in HBs should be suitably sourced and integrated with existing materials, whereas new materials should be recognized and kept under review. Finally, Dann et al (1999) called to fit the new to the old (and not the other way round).

In brief, the main principles of intervention in historic buildings which provide a guide for dealing with HBs as discussed could be included in five principles:

- Minimal intervention
- Like-for-like repairs (materials and methods)
- Repairs should be reversible
- Repairs should be sensitive
- Truth to materials, in terms of distinguishing old and new materials

However, the extent of compliance with these principles was observed in six HBs in Tripoli city.

3. Methodology

The objectives of this paper are to observe the physical conditions of a sample of historic buildings (HBs) in the city of Tripoli, Libya and, evaluate the extent of compliance or contradiction of repairs, with architectural conservation principles. Also, it shed a light on the main reasons those lead to contradiction with these principles. In order to achieve this objective, a field research was conducted in the city of Tripoli, Libya in 2010. The method of data collection was observations that included six historic buildings; these buildings were six of eight HBs were repaired recently or under repair during the period of field research. Administrative constraints prevented accessing the rest two HBs. However, note taking, asking questions, taking photographs were helpful tools used for conducting the observations. The findings were compared with the architectural conservation principles and analysed qualitatively and quantitatively.

4. The Findings of Observations

Six HBs in the city of Tripoli, Libya were observed; Al-Mushat Mosque, Arts and crafts school, Islamic museum, former British Consulate, former bank of Romeand, former French Consulate. These buildings were under repair or repaired a few years ago.

4.1. Former British Consulate

This historic building is located in the old city of Tripoli, Libya. According to a label next to the main entranceit was built in 1744 (Figure 1).

a	Dampness in walls as a result of using Portland cement mortar for plastering		
b	Exaggerated and inappropriate use of reinforced concrete for treating cracks in previous repairs		
c	Inappropriate metal ties were used to support arches caused cracks in columns		

Figure 1: Former British Consulate, Tripoli, Libya (Author, 2010)

4.2. The Arts and Crafts School

This historic building is located in Tripoli, Libya. According to a label next to the main entrance,this school was built in 1898 (Figure 2).

	Exaggeration use of reinforced concrete to consolidate the foundations		

Figure 2: Arts and Crafts School, Tripoli, Libya (Author, 2010)

4.3. The Former Bank of Rome

This historic building is located in the old city of Tripoli, Libya. According to a label next to the main entranceitwas established on the second Ottoman Era (1835-1911) (Figure 3).

a	The elevation of bank of Rome was restored according to an old photograph.		
b	Although refurbishment works were conducted 6years ago, this building suffers from high dampness in walls, this attributed to use cement mortar for plastering		
c	For security reasons (currently this building is used as a Bank), a modern material was used to cover the internal courtyard.		

Figure 3: Former Bank of Rome, Tripoli, Libya (Author, 2010)

Al-Mushat Mosque

This historic building is located in the old city of Tripoli, Libya. According to a label next to the main entrance,the Mosque was built in the 15th century and the minaret was built in 1670 (Figure 4).

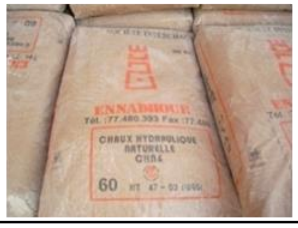
a	Consolidation of cracked walls during refurbishment work to avoid the risk of failure		
b	Monitoring the cracks is essential for assessing building's condition		
c	Repair work depended on removing all plaster layers internally and externally		
			
d	imported materials (hydro carbonate lime and lime) for plastering		
e	A hydro carbonate lime mixture was tested and used for re-plastering		

Figure 4: Al-Mushat Mosque, Tripoli, Libya (Author, 2010)

4.5. The Islamic Museum

This building is located in Tripoli, Libya. According to a label next to the main entrance it was built between 16-18th century (Figure 5).

a	Checking the extent of cracks to observe the movement of walls		
b	Underground water supply, sewage system and central air conditioning were established adjacent to the Islamic Museum		
c	A pre stressed metal ties were used to support arches		
d	Repairing decayed wood works and corrosion in metal works - Original special features were conserved		
e	Materials were imported for repairing work		

Figure 5: The Islamic Museum, Tripoli, Libya (Author, 2010)

4.6. The Former French Consulate

This historic building is located in the old city of Tripoli, Libya. According to a label next to the main entranceit was established between the 16th and 17th century (Figure 6).

a	Restoring the original wood work using the same material		
b	Distinguishing old and new wall ceramic		
c	The electric wires were lined randomly in walls that affect negatively on walls		
d	Re-plastering the affected areas and wood framework was used for supporting walls		

Figure 6: Former French Consulate, Tripoli, Libya (Author, 2010)

5. Discussion

The work done in HBs sites includes good and bad interventions. This section evaluate to what extent the interventions comply with architectural conservation principles and, shed a light on the factors those led to contradiction with these principles on observed HBs.

5.1. The Main Problems in Observed Historic Buildings

Cracks, dampness and wearing out of materials are the main problems that most observed HBs suffer from. In addition to cracks in walls and roofs (Figure 4-B and 5-A), some columns' crowns (Figure 1-C) suffer from cracks as well. Also, most walls of observed HBs are suffering from dampness (Figure 1-A and 3-B). Furthermore, decay of materials, particularly wood is a common problem in historic buildings. However, the set of observations demonstrated that dealing with these problems included mistakes and defects in addition to good work.

5.2. The Interventions and the Extent of their Compliance with Conservation Principles

The works done as observed are categorized into four sections: consolidating HBs and treating cracks, dealing with dampness, replacing and restoring the original features of facades and, providing services and security. This section concluded with statistical results.

5.2.1. Consolidating HBs and Treating Cracks

Numerous notes were observed regarding consolidating HBs and treating cracks: supporting the cracked walls during the repair work, checking the expansion of cracks, supporting foundations, treating cracks and supporting arches.

The first observed note is supporting the cracked walls during the repair work in al-Mushat mosque (Figure 4-A). This process is essential work that should be done in HBs to avoid more damage or a risk of failure. According to British standard 7913 (1998), the priority should be given to the "work which should be put in hand without delay for public safety or healthy and safety reasons, to prevent imminent damage or to arrest rapid deterioration". Supporting the cracked walls is at the top rank of the priority of work in HBs and complies with 'Repairs should be sensitive' principle.

The second set of observed notes is regarding the process of checking the expansion of cracks in Al-Mushat mosque and Islamic museum walls (Figure 4-B and 5-A). Expansion of crack gives an indication that there is a foundation or a wall problem, whereas stability of crack indicates that the situation is unharmed. Diagnosing HBs' condition is an essential work for conserving them, as (Brereton, 1991: 7) stated: "It is essential to identify causes before specifying remedies and in pursuit of this there is a need for a careful and accurate diagnosis including, where appropriate, monitoring of the structure". This complies with 'repairing should be sensitive' principle.

The third set of observed notes is regarding supporting foundations and treating cracks. For supporting the foundations of arts and crafts school there is an exaggerated use of reinforced concrete (Figure 2). This contradicts with conservation principles in terms of 'minimal intervention'. The main reasons for the contradiction in this case are uncertainly and lack of knowledge about the required reinforced concrete or other material to keep the building safe. Furthermore, harmful use of reinforced concrete for treating cracks in former British consulate (Figure 1-B) contradicts with conservation principles in terms of minimal intervention and repairs should be sensitive and repairs should be reversible. However, lack of knowledge regarding treating cracks in such case is the main reason that led to contradiction with conservation principles.

The fourth set of observed notes is regarding the consolidation of arches. In former British consulate, wrong metal ties were used for supporting the arches horizontally, caused cracks in the capitals of arches (Figure 1-C). This contradicts with repair should be sensitive principle. The main reason led to the contradiction in this case is lack of knowledge regarding proper metal ties for supporting arches**.** However, in Islamic museum, a pre-stressed metal ties were used to prevent horizontal forces in arches (Figure 5-C). This process complies with repair should be sensitive principle.

5.2.2. Dealing with Dampness

The intervention for treating dampness as observed in numerous HBs includes: removing all old plaster layers and re-plastering the walls.

In al-Mushat Masjid, for treating dampness in walls and ceilings, the repair work depended on removing all old plaster layers of the internal and external walls, ceiling and the dome (Figure 4-C). This is also what occurred in previous refurbishment works in former British consulate (figure 1) and former bank of Rome (Figure 3). In addition to harming and reducing the value of HBs fabric it causes increase the cost of repairing work. More harming might be incurred because of uncovered external walls and domes during rainy season (before re-plastering). This contradicts with conservation principles in terms of minimal intervention and repairs should be sensitive. Repetition of the same

mistake in different sites attributed to lack of knowledge. However, identifying and repairing the specific affected areas in former French consulate (Figure 6-D) are economic, easily measured and comply with minimal intervention; repairs should be sensitive and truth to materials principles.
The second set of observed notes regarding treating dampness is using ordinary cement mortar for re-plastering the walls and ceilings in former British consulate (Figure 1-B), and former bank of Rome in Tripoli (figure 3-B). Plastering the walls with ordinary cement mortar caused the continuity of the same problem of dampness and a serious damage to the HBs fabric because condensation built up within a stone. In historic buildings, "the free movement of water vapour through the fabric of a building in both directions is essential" (Council, 1998). This can be achieved when porous materials such as lime components are used for plastering. Moreover, plastering the walls with ordinary cement mortar gives a new appearance to historic buildings. In other terms HBs appear as new buildings. The use of inappropriate materials results in a damage to the cultural value of historic buildings (HECC, 2010). Due to the damage and giving new appearance to historic buildings, using ordinary cement mortar for plastering HBs' walls and ceilings contradicts with 'minimal intervention', 'like for like repairing', 'repairs should be reversible', 'repair should be sensitive', and 'truth to materials' principles. Unavailability of proper materials in local market (Ordinary cement is a common material whereas, lime components are not available often in Libyan local market) and lack of knowledge (repetition of the same mistake in different sites) are the reasons led to contradiction with conservation principles. However, in recent restoration projects (Al-Mushat mosque and Islamic museum) hydro carbonate lime components were imported for these projects and used for re-plastering (Figure 4-D, 4-E and 5-E). This complies with 'like for like repair' principle.

5.2.3. Replacing and Restoring the Original Features of Facades
The missing cantilevered window in the main facade of former bank of Rome (Figure 3-A) was restored according to the original features that are taken from old photographs. These photos and their dates tell us about what old and new in HBs, and also the alterations which occurred in them. This helps for conducting restoration processes correctly and contributes with achieving 'Like-for-like repairs' principle. Furthermore, in Islamic museum old wood works and corrosion in metal works were repaired. Repairing rather than replacing original wood and metal works contributes with achieving 'repair should be sensitive' and 'minimal intervention' principles. However, in former French consulate although the old wood windows were available during previous refurbishment, uncertainty of its durability (a safety reason) prevented applying repair above replacement or 'minimal intervention' principle, and the original windows is replaced with new windows made of the same materials and method achieving 'Like-for-like repairs' principle (Figure 6-A).
Furthermore, in former French consulate, damaged ceramic works in the inner courtyard were replaced with new ones using the same size, materials and colours. However, old and new wall ceramic works were distinguished (Figure 6-B). This complies with 'truth to materials' and 'like-for-like repairs' principles.

5.2.4. Provision of Services and Security

In former French consulate the electric wires were lined randomly in walls that affect negatively on walls (Figure 6-C). This contradicts with 'minimal intervention' and 'repairs should be sensitive' principles. The reason that led to contradiction with conservation principles might be attributed to lack of knowledge. However, in Islamic museum (Figure 5-B), underground facilities were established adjacent to the historic building to provide sewage, water and air conditioning systems. The concept was to make these services are hidden and ensure that they do not affect negatively on the building. This complies with 'repairs should be sensitive' principle.

Finally, the internal courtyard of former bank of Rome (Figure 3-C) is covered with modern demountable materials. This attributed to the new function of this building is a branch of al-Umma bank (Libyan bank). Although modern materials are inappropriate for HBs, a security reason forced the contradiction with 'like for like repair' principle**.** However, using materials which can be dismantled and removed from their setting comply with HBs conservation principles in terms of 'Repairs should be reversible'.

5.2.5. Statistical Results Analysis

Statistically, forty two observations were taken from six historic buildings in the city of Tripoli, Libya. The statistical results illustrated that around 40% (17/42) of the observed work done comply with architectural conservation principles (Table 1). Like-for-like repairs and truth to materials principles got respectively 62.50% and 50% of compliance. Whereas repairs should be sensitive, repairs should be reversible and minimal intervention principles got respectively 46.66%, 25% and 18.18%of compliance. The results demonstrated a low percentage of compliance with architectural conservation principles in observed HBs.

Table1: the percentage of the compliance of work done with conservation principles.
√: Compliance, X: Contradiction (more than one √ or X means more than one building)

The work done in the historic buildings / Architectural conservation principles	Like-for-like repair	Truth to materials	Sensitive repair	Reversible repair	Minimal intervention
Al-Mushat mosque: supporting the cracked walls during the repair work			√		
Al-Mushat mosque and Islamic museum: checking the expansion of cracks in walls			√√		
Arts and crafts school: an exaggerated use of reinforced concrete for supporting the foundations					X
Former British consulate: harmful use of reinforced concrete for treating cracks in walls			X	X	X
Former British consulate: wrong metal ties were used for supporting arches			X		
Islamic museum: a pre-stressed metal ties were used to prevent horizontal forces in arches			√		

Al-Mushat mosque, former British consulate and former bank of Rome: removing all plaster layers			X X X		X X X
Former French consulate: repairing the specific affected areas		√	√		√
Former British consulate, and former bank of Rome: using ordinary cement mortar for re-plastering	X X	X X	X X	X X	X X
Al-Mushat mosque and Islamic museum: lime components were used for re-plastering	√√				
Former bank of Rome: the main facade was restored according to old photographs	√				
Islamic museum: repairing rather than replacing original wood and metal works			√		√
Former French consulate: the old windows replaced with new windows made of the same materials and method	√				X
Former French consulate: old damaged ceramics were replaced with new ones have same design and materials and distinguishing old and new ceramics.	√	√			
Former French consulate: the electric wires were lined randomly in walls			X		X
Islamic museum: underground hidden facilities were established adjacent to HB to provide sewage, water and air conditioning systems.			√		
Former bank of Rome: the internal courtyard is covered with modern demountable materials	X			√	
The percentage of the compliance of work done with architectural conservation principles	(5/8) 62.5%	(2/4) 50%	(7/15) 46.66%	(1/4) 25%	(2/11) 18.18%
	Average: (17/42) 40.47 %				

6. Conclusions

The objectives of conducting this research were to evaluate to what extent the interventions in historic buildings in Tripoli, Libya comply with historic buildings conservation principles and, shed a light on the main reasons those led to contradiction with these principles.

The main problems that most observed HBs suffer from were cracks, dampness and wearing out. A set of observations led to identify good repair works which mostly comply with conservation principles and, contribute with using HBs properly and extent their lives. Good works can be included in supporting the cracked walls during the repair work, checking the expansion of wall cracks, repairing the specific affected areas, using lime components for re-plastering, using pre-stressed metal ties for supporting arches, restoring the original features of facades, distinguishing old and new materials, using reversible materials, and hiding modern facilities. On the other hand, the observations, led to identify the main repeated mistakes and defects that were occurred in repair works. the main repeated mistakes and defects that were occurred can be concluded in: removing all old plaster layers, using ordinary cement mortar for re-plastering, exaggerating and misusing of reinforced concrete for supporting foundations and treating cracks, and using inappropriate metal ties for supporting arches. These defects caused damages to HBs and contradicted with conservation principles.

The most contradictions with conservation principles in observed HBs are: exaggerated intervention, using non-reversible materials and insensitive repairing. According to 42 observations in six HBs, the percentage of compliance with architectural conservation principles is about 40% (17/42).The repeated defects and mistakes which contradict with conservation principles are attributed to lack of knowledge regarding proper repairing materials and methods. The other reasons those lead to contradiction with conservation principles are: unavailability of proper repair materials in local market and, safety and security reasons.

Finally, observing current and previous repair works is a significant source of knowledge in terms of lessons learnt from successful and non-successful experiences. These lessons should pass into future repair works that will be achieved in historic buildings to avoid repetition of mistakes and ensures applying conservation principles.

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