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Ethical Guidelines for Structural Interventions in Small-Scale Historic Stone Masonry Buildings

Abstract

Structural interventions to historic stone masonry buildings require consideration of both structural and heritage values simultaneously. The absence of one of these value systems in implementations can be observed as an unethical professional action. The research objective of this article is to prepare a guideline for ensuring ethical structural interventions of small-scale stone historic masonry buildings in the conservation areas of Northern Cyprus. The methodology covers an analysis of internationally accepted documents of conservation and national laws related to conservation of historic buildings; an analysis of building codes, especially Turkish building codes, which have been used in Northern Cyprus; and an analysis of the structural interventions introduced to a significant historic building in semi-intact state in the walled city of Famagusta. This guideline covers the issues of buildings as being intact or ruined, the presence of earthquake risk, types of structural decisions during an architectural conservation project, and the values to consider during the decision-making phase.

Keywords: Structural interventions, ethics, conservation, stone masonry, historic buildings

1. Introduction

Interventions to historic buildings has long been practiced in order to adopt them to the changing needs and to make use of contemporary technological opportunities. Among various types of interventions varying from minor to major, structural interventions constitute a significant place due to demand for structural safety against the possible decay of historic buildings throughout the timeline. This paper argues that any structural intervention to historic buildings should be considered and assessed through the ethics of conservation. As emphasised in several internationally accepted documents and publications, conservation process should maintain the cultural significance of a heritage building and interventions should be integrated with the whole while retaining its integrity and character. (ICOMOS 1964; ICOMOS 1979; ICOMOS 1994; Jokilehto 2002; Matero 1993; Malkogeorgou 2006; Rodwell 2007; Semes 2009; UNESCO 1972). Such a statement raises the dilemma of blending old and new together with the level of intervention and its necessity. The existing literature about the subject provides ground for general issues whereas the ethics of structural interventions to historic buildings is still open for discussion. Hence, this study aims to contribute to the related literature by focusing on adaptation of historic stone masonry buildings to contemporary needs which is also a challenging subject due to following reasons:

- The presence of different approaches to intervening historic masonry buildings and the changing understandings of the ethical concepts of conservation regarding these interventions,
- Developments in stone masonry technology, with the use of reinforced masonry and the possibility of integrating masonry structures with frames,
-Consideration of the weakness of traditional stone masonry buildings against earthquakes and the opportunity to take life-saving safety measures using contemporary approaches to masonry.

The historic masonry buildings covered within the content of this study are located in conservation areas, and thus the focus of the article is on both conservation ethics and ethics for making structural interventions to listed stone masonry buildings. While the ethics of conservation is mainly guided by internationally accepted documents, ethics of making structural interventions are based on engineering ethics and local building codes. Existing literature on architectural ethics (Fisher 2008; Fisher 2010; Harries 1997) does not cover the contradictory situations between two or more value systems. Harries (1997) addresses the ethical values about meaning in architecture, difference of dwelling from other types of architecture and effect of architecture on community. Fisher (2010) analyses the obligations of architects towards public, the client, the profession, colleagues and the environment. In his other book, Fisher (2008) gives some advices about architecture's relation to safety requirement, nature, consumption, economy and community. As regards to the necessity of considering ethics of different disciplines, conservation projects may become complex by means of its ethical approach. In other words, the best design according to conservation ethics might contradict to the best design according to engineering ethics and building codes. Taking such an ethical contradiction as a problem that requires research, the hypothesis of this study can be stated as: if conservation ethics and ethics for structural design are not considered simultaneously, the outcomes will be ethically unsuccessful.

The inquiry of dealing with contradicting aspects of above mentioned architectural requirements, local building codes, conservation and engineering ethics has helped the determination of case study as walled city of Famagusta in Northern Cyprus, where adaptation of the approximately 150 stone houses into boutique hotels is currently on the agenda of the state. Yet, the existing laws and regulations describe the limitations for physical interventions in a way that are open to interpretation leading uncontrolled developments and harm the cultural significance of the site. Accordingly, the research objective of this study is set as to understand the interaction between conservation ethics and the ethics of making structural interventions and to develop applicable guidelines for the stone masonry buildings within the conservation areas of Northern Cyprus. The first two steps to achieving this objective involves analysing building codes for stone masonry (especially the Turkish building codes) and internationally accepted documents about conservation to determine the guidelines from the points of view of conservation and structural design. The third step involves examining a historically significant example, namely, a restored stone masonry building in the walled city of Famagusta, Northern Cyprus. Finally, guidelines for adapting historic stone masonry houses to contemporary needs are developed and the outcomes of the research are presented in conclusion.

2. The Technical Limitations of Making Structural Interventions to Stone Masonry Buildings

This heading covers the analysis of building codes, especially the Turkish building codes, which are used in Northern Cyprus, in order to understand what type of limitations should be considered for making structural interventions on small-scale stone masonry buildings. The initial step for structural interventions to a historical stone building should be the selection of a structural system. There are many different types of stone masonry structures that can serve for this purpose:

- Traditional stone masonry structures with timber horizontal tie-beams, floor and roof structures,
- Reinforced stone masonry to increase the earthquake resistance of the structure (including reinforced concrete or steel elements),
- Hybrid systems of reinforced stone masonry and frames, which can also increase earthquake resistance.

The limitations to be considered for making structural interventions change depending on the selected type of structural system.

2.1. The technical limitations of making interventions to traditional stone masonry

Table 1 shows the structural requirements for new stone masonry structures according to Turkish Building code (Ministry of Public Works and Settlement Government of the Republic of Turkey 2007) which is valid in Northern Cyprus.

Table 1 Structural requirements for traditional stone masonry structures in Northern Cyprus

Structural requirement if there is high earthquake risk	Structural requirement if there is low earthquake risk
Wall thickness should be minimum 50 cm.	Wall thickness should be minimum 50 cm.
Space dimensions should not exceed 5,5 meters.	Space dimensions should not exceed 7,5 meters.
Wall height should not exceed 3 meters.	Wall height should not exceed 3 meters.
Cut stone buildings can be maximum 2 storeys high.	Cut stone buildings can be maximum 4 storeys high.
Plan configuration should be either symmetrical or close to symmetrical.	Plan configuration should be either symmetrical or close to symmetrical.

Total length of openings should not exceed 40% of total wall length.	Total length of openings should not exceed 40% of total wall length.
Maximum opening size is 3 meters.	Maximum opening size is 3 meters.
Distance of openings from the building corners should be minimum 1,5 meters.	Distance of openings from the building corners should be minimum 1 meter.
Openings should be minimum 0,5 meters away from wall intersections.	Openings should be minimum 0,5 meters away from wall intersections.
Distance between two openings should be minimum 1 meter.	Distance between two openings should be minimum 0,8 meters.
There should be reinforced concrete or steel horizontal tie-beams at floor levels and roof level.	There should be reinforced concrete or steel horizontal tie-beams at floor levels and roof level.
There should be reinforced concrete foundations under the walls and they should be designed by considering site and soil conditions.	There should be reinforced concrete foundations under the walls and they should be designed by considering site and soil conditions.

It is clear that applications differ considerably depending on the presence of earthquake risk. However, it should also be noted that the building codes of some countries do not accept the use of traditional masonry structures if there is earthquake risk (Eurocodes Committee 2004). Turkish building codes accept the use of stone masonry structures with reinforced concrete horizontal tie-beams and reinforced concrete foundations even if there is seismic risk. However, it encourages the use of reinforced masonry if there is earthquake risk (Ministry of Public Works and Settlement Government of the Republic of Turkey 2007).

2.2. Making interventions to achieve reinforced stone masonry buildings

There are three possible types of reinforced masonry, as seen in Fig. 1.

- The cavity within the masonry wall can be filled with reinforced concrete,
- Reinforcement can be placed between masonry pieces,
- Vertical tie-beams (confined masonry) can be used (Ambrose 1991; Fodi and Bodi 2011).

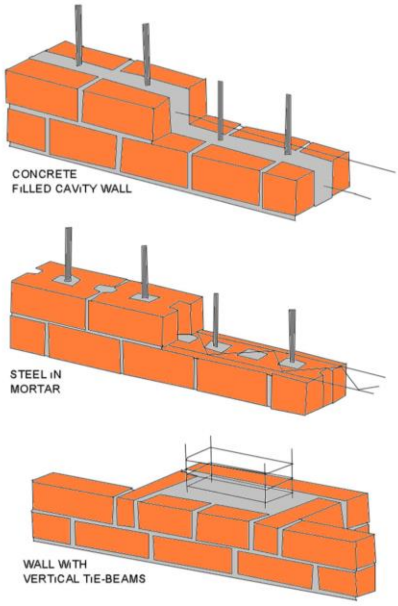

Fig. 1. Types of reinforced masonry

However, the most applicable reinforced masonry type used in the restoration of small-scale stone masonry buildings is the reinforced stone masonry with horizontal and vertical tie-beams. The other alternatives can damage the nature of historical stone walls. These tie-beams can be reinforced concrete or steel. It should be remembered that the presence of these tie-beams does not transform the structure into a frame system. They do not change the masonry nature of the structure. The frequency of tie-beams can vary. There can be vertical tie-beams only at the corners of the buildings, tie-beams at every wall intersection, or tie-beams at every wall intersection and on the two sides of all openings.

Table 2 shows the differences which can be achieved by using reinforced masonry in comparison to traditional masonry application which is shown in Table 1.

Table 2 Changes due to use of reinforced masonry (Ministry of Public Works and Settlement Government of the Republic of Turkey 2007)

Structural requirement if there is high earthquake risk	**Structural requirement if there is low earthquake risk**
If vertical reinforced concrete tie-beams are used at the intersections of walls and at the two sides of all openings, the length of reinforced stone walls between two wall intersections can be a maximum of 16 metres	If vertical reinforced concrete tie-beams are used at the intersections of walls and at the two sides of all openings, the length of reinforced stone walls between two wall intersections can be a maximum of 16 metres
Total length of openings should not exceed 60% of total wall length.	Total length of openings should not exceed 60% of total wall length.

Distance between two openings should be minimum 0,5 meters.	Distance between two openings should be minimum 0,5 meters.

The other requirements listed in Table 1 are also valid for reinforced masonry.

2.3. Making interventions to achieve a hybrid system of reinforced stone masonry and frame system

This type of a structure is a composition of reinforced masonry and frame parts as seen in Fig. 2. The reinforced stone masonry parts of the structure should be designed according to the recommendations made about reinforced stone masonry systems. Similarly, the reinforced concrete or steel frame parts of the structure should be designed as reinforced concrete or steel frame systems. Structural continuity between the two structures will be provided by connecting the reinforced concrete elements in both systems to each other as seen in Fig. 2. According to American building codes, connecting parts between the two systems should be designed to resist interconnecting forces and to accommodate calculated deflections (ACI 530-02/ASCE 5-02/TMS 402-02 2002). The reinforced masonry walls in both orthogonal directions should be evenly distributed in the plan to avoid twisting instability problems due to earthquake loads.

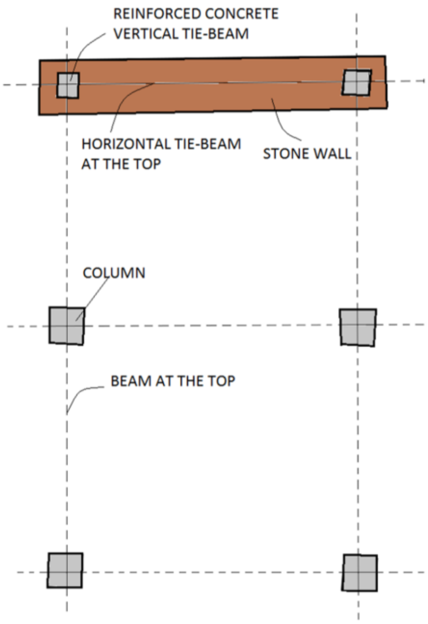

Fig. 2. Hybrid of reinforced masonry and frame

Use of this type of a structure can be very effective for ruined buildings in which some stone walls have already collapsed.

2.4. Ethics of making interventions in stone masonry structures from the point of view of structures

Achieving the same level of safety with new stone masonry structures can be considered the main ethical requirement of making interventions in existing stone masonry structures. Building codes should be made applicable for the restoration of existing buildings too. Thus, reinforced stone masonry or a hybrid of reinforced stone masonry and a frame should be preferred if there is earthquake risk. It is also possible to use cross-walls and buttresses to increase the earthquake resistance of the structure. Whatever the selected structure type is, transforming the existing building radically is technically possible. However, the spatial dimensions and opening arrangements should be made according to the safety requirements of the selected structural system.

3. Conservation Ethics for Making Structural Interventions

The ways of structurally intervening stone masonry buildings in line with the ethics of conservation are presented under this heading. Ethics encapsulated within the building conservation philosophy is discussed by extracting concepts from the main literature and internationally accepted documents of architectural conservation. Following this identification, local laws and regulations are analysed in light of the international framework, and the validity and adoptability of these ideals to the actual situation are discussed through the case study.

3.1. The Internationally Accepted Ethics of Conservation

To extract the key concepts of conservation, we considered scholarly and internationally accepted documents of conservation as seen in Table 3.

Table 3 The internationally accepted ethics of conservation (ICOMOS 1964, UNESCO 1972, ICOMOS 1979, ICOMOS 1994)

Internationally accepted documents for conservation versus concepts of conservation		Venice Charter	World Heritage Convention	Burra Charter	Nara Document on Authenticity
Authenticity	protecting monuments with their full richness and authenticity	■			
	importance of the use of original materials and techniques in restoration	■			
	retaining as much of the original fabric as possible		■		
	conserving cultural significance of places and the original fabric			■	
	relating authenticity judgements to form, design, materials, function, structural traditions, techniques and use			■	■
	importance of all aspects of sources for conservation, including materials, traditions and techniques				■
	clarifying definitions regarding the concept of authenticity				■
Integrity	respecting valid contributions of all historic periods since unity of style is not the aim of a restoration	■			
	importance of a balance between new additions and historic fabric	■			
	designing new additions as distinguishable from the original and in harmony with the whole fabric				
	satisfying the conditions of integrity for all properties nominated for inscription on the World Heritage List		■		
	integrity as a measure of the wholeness and intactness of the cultural heritage and its attributes		■		
	advocating a cautious approach to physical change when maintenance of original use is not possible			■	
	respecting the traces of additions, alterations and earlier treatments to the historic fabric as evidence of its history			■	
	conceiving integrity in the spirit of the Charter of Venice				■
	extending the former concept of integrity in response to the expanding scope of cultural heritage concerns and interests in our contemporary world				■

In light of the abovementioned ethical concepts of conservation, the stated documents also provide guidance through the main principles for achieving those ethical standards. In terms of structural interventions to buildings under conservation, it is advised to keep the interventions minimal. In case intervention is inevitable, it should be distinguishable from the existing and reversible.

3.2. Current Regulations for the Interventions in Famagusta

The conservation of the walled city of Famagusta is governed by laws, as it has been a designated conservation area since 1990. In the constitution of the Turkish Republic of Northern Cyprus, there are four sections that are related to the protection of historical and cultural heritage (Sections 36, 39, 40 and 42). There are also laws that indirectly influence the protection of cultural and historical heritage (such as the Law of Rent (17/81) and Social Housing Law (23/78)), which have a partial effect on historic quarters. Although the city retains its medieval character in terms of scale and silhouette, measures taken for its conservation have not reached a satisfactory level in terms of both cultural and economic sustainability. Considering that there has been a growing demand for physical upgrading of the historic city, there are many projects that cannot be approved by the authorities due to the limiting nature of regulations and lack of detailed guidance which lead some inhabitants applying interventions without following legal approval process. This type of uncontrolled development or abandonment of historic fabric due to restrictions is harmful to the cultural significance of the city as a whole.

In general, lack of an up-to-date vision towards architectural conservation can be observed in the current legislation. Since this study aims at long-term cultural and economic sustainability for the area, it suggests that the historic masonry buildings should be used by their inhabitants so that dereliction of historic buildings can be prevented. Such an approach will attract not only the owners of the historic masonry buildings but also stakeholders for tourism investment. Regarding that there is already an initiative by the Ministry of Tourism for funding the reuse of historic buildings for boutique hotel purposes; the outcomes of the study will help increase in the number and efficacy of initiatives. Therefore, in terms of current legislation, a special law for the walled city of Famagusta should be enacted and reviewed regularly in line with international understanding and ethics.

4. Case Study: A Historic Stone Building in Famagusta

The traditional houses of Cyprus have developed through experience in accordance with the availability of materials, climatic considerations, functional requirements and topography (Florides et al. 2001). Regarding the structural terms, adobe and stone are the two main materials for constructing masonry houses (Günce et al. 2008). While adobe is the prevailing construction material in plain areas, stone replaces it in the mountain areas of the rural lands (Dincyurek et al. 2003). In addition, the ways in which the materials are used and shape the architectural characteristics of traditional houses show variations as per the period they were built. Looking at the existing traditional houses, elements of the Ottoman (1571–1878), British (1878–1960) and Modern (1960–) periods are dominated the architectural characteristics in the urban areas (Ozay 2005). During the Ottoman and British periods, local materials and traditional construction techniques were used. The plan schemes and proportion of the building elements exhibit variations during these periods depending on changes in the lifestyles (Ozay 2005).

Within the case study area of the walled city of Famagusta, most of the historic building stock, including the fortification walls, churches, and warehouses along with the residential buildings, are of stone masonry. The vast use of stone as a building material in Famagusta is due to its availability because the city was founded on natural bedrock forming a natural small harbour on the sea coast (Langdale 2012). Simply called *yellow stone* locally, this type of sand stone has been used in Cyprus for ages to build masonry structures because it is abundant, relatively easy to cut and shape and performs well in many applications (Eren and Bahali 2004). However, it is a porous sandy limestone and thus susceptible to water absorption and erosion, which has led visible decay in most of the historic buildings in Famagusta (Lourenço et al. 2012). Considering that the city was founded in the 10th century on the site of ancient Arsinoe, dating 3rd century B.C., the historic buildings have been subjected to ongoing weathering throughout the city's long history. Over eleven centuries, a significant number of monumental and residential buildings were constructed within the well-protected fortification walls (Langdale 2012). Among them, mainly churches remain from the medieval period, either in a ruinous state or intact. Today, there are very few residential buildings remaining from the medieval period; most are from the Ottoman and British periods. The building examined in this study is a rare example in the walled city of Famagusta. It was built during the early Ottoman period and has some upper spaces extended to the street with the help of an open arcade providing traffic flow underneath.

4.1. Analysis of the Case Study

The case building is located on the intersection of Ali Pasa Street and 28 Mehmet Celebi Street, towards the southwest of St. Peter and Paul Church (Fig. 3). The building is erected on a corner plot having an extension towards Ali Pasa Street on the upper floor, which stands on a single arch (Fig. 4). It is a two-storey stone masonry building covered with a timber hipped roof. Considering the state of the building before restoration, it had some ruined spaces that were put into use with an additional iron and glass structure. The building's entrance is from Ali Pasa Street, with four spaces on the ground and two spaces on the first floor (Fig. 5). The dimensions are approximately 10.9 m x 11.6 m. The highest point is 8m for the roof and 4.1 m for the arched opening. The building has undergone a restoration process lasting approximately six months, yet to be completed.

Fig. 3. Map of the walled city of Famagusta showing the location of the case building (URL1, n.d.)

Fig. 4. Southwest façade of the historic house (Photo by …….)

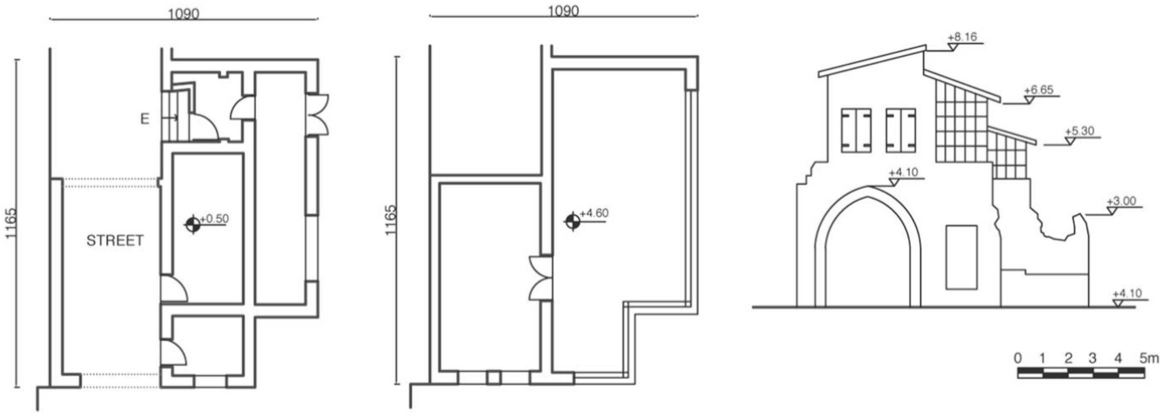

Fig. 5. Ground floor, first floor plans and south elevation of the arched house before restoration (Drawn by …….)

Concerning the physical interventions implemented during the restoration process, this study finds it convenient to take the building as a case for developing a critical debate on ethical concerns in adapting historic masonry structures to contemporary needs due to following reasons:

-the building is very significant due to being a rare example of its type,

-there were some missing/ruined parts of the building in its former state,

-the interventions mainly comprise structural additions for strengthening purposes,

-the reconstruction of missing parts also provides a critical ground for the study's debate,

-there are many other residential buildings in Famagusta that require adaptation to contemporary needs; thus, any assessment and suggestions for the case building can provide a basis for others.

4.2. Analysis of Interventions

One important decision in the restoration of a historic building is the development of an approach for the missing parts. As stated in the Venice Charter's 9th article, conjecture should be avoided in any restoration work. Replacement of missing parts should be done in a way that can be distinguishable from the original parts so as to not cause falsification. With this in mind, the approach for the case building is considered inappropriate when comparing its actual state to its former one. As seen from the Fig. 6, the building had some missing and ruined parts, which were later replaced based on conjecture and are not easy to distinguish from the original parts.

Fig. 6. The state of the building before restoration (a) and after restoration (b, c) (Photos by …….)

Looking at the plan scheme and its reflection in the mass of the building's current state, during restoration work, the building was enlarged towards the south, occupying extra space on 28 Mehmet Celebi Street to provide larger rooms for the ground and first floors. The façade arrangement was also designed based on assumptions by looking at the façade order and elements of other neighbouring residential buildings. Other major interventions took place on the eastern part of the building facing a church. While the building had some traces indicating that it extended towards the east, with the restoration work, that part was also completely changed (Fig. 6c).

Based on the major interventions introduced to the building, the structural system has also changed. Constructed with a load bearing masonry system, the main materials used in the building are local stone for walls and timber for floors and the roof. The building has a cut stone form bound with locally produced mortar containing earth, stone powder and gypsum. The walls are 60 cm thick, which decreases to 40 cm on the upper floor. Two single arches are used to span the street carrying the upper floor. Timber beams are used with approximately 30 cm intervals to form the floor system spanning the narrow distance, finished with timber floor. The roof is a simple hipped roof constructed with a timber truss system. Timber is also used as a lintel to span window and door openings.

During the restoration work, new structural elements were introduced. The original elements remained but with several interventions, such as the following:

-Reinforced concrete foundations were added to the existing stone masonry,

-The timber horizontal tie-beams were replaced with reinforced concrete horizontal tie-beams,

-Reinforced concrete lintels were introduced on window and door openings,

-Cement mortar was used in the reconstruction of ruined parts to bind the local stone (Fig. 7)

Fig. 7. The uses of concrete beams and cement mortar for the restoration work (Photo by ……)

-Steel beams were added to carry the floors, and the timber beams were removed (Fig. 8),

-The steel beams were supported by steel trusses supported by the stone masonry wall,

-The timber floors were replaced with plywood panels, mainly *osb*- oriented strand board,

-The roof was replaced with a steel truss roof.

Fig. 8. Steel beams added during restoration work. (Photos by ……)

4.3. Assessment of Structural Interventions from Conservation Point of View

Although the analysis of interventions offers a ground for discussing the different aspects of ethics of conservation, within the limitations of this study, only structural interventions will be assessed and discussed. The assessment is carried out according to the level of intervention in relation to the significance of the building, respect for authenticity, the necessity of new additions and their relation with the historic fabric, and respect for integrity rather than falsification.

- Respecting the value held by each historic building, some buildings require much sensitivity due to their high degree of significance during restoration work. The case building is such an example. Due to its rarity and its historic, scientific, cultural and environmental values, its degree of significance is high and calls for minimum intervention. However, the interventions introduced, including the structural additions, are major.

-As stated in the Nara Document on Authenticity (ICOMOS 1994), authenticity judgements may be linked to a variety of sources comprising materials, techniques and hence structure. In the case building, the use of different structural systems and materials may be necessary (but this should still be questioned), yet the way in which it is integrated with the historic fabric threatens its authenticity. In addition, the use of cement is also harmful for stone masonry because of its acidic content. Reinforced concrete can be used with this type of building only if white cement is used (Juhasova et al. 2008; Pieper 2002).

-Buildings may require some interventions due to aging or adaptation for contemporary needs, but the necessity of any addition or intervention should be questioned, as stated in the 10th article of Venice Charter (ICOMOS 1964). Such interventions are allowed when traditional techniques are inadequate. If done, they should both integrate with the entirety of the building and be distinguishable, as stated in the 12th and 13th articles of the same document. In the case building, the inquiry of structural support may have been necessary, yet the use of reinforced concrete tie-beams, additional steel beams and trusses is considered as inappropriate. Reinforced concrete is harmful for stone masonry. Further, the steel elements do not integrate harmoniously with the entirety of the buildings and, although they are distinguishable. Another concern is that some of the steel work will be hidden by suspended ceilings in the finished form and thus not visible, leading falsification at certain parts.

-Falsification is an important concern for the arched house. In addition to the replacement of missing parts based on conjecture, hiding additional structural elements while keeping the historic ones will definitely lead to falsification. In other words, the timber beams that are visible to people who walk underneath the arch on the street will no longer be real structural elements but will appear to be.

4.4. Assessment of Structural Interventions from Structural Point of View

The Turkish building code is used in Northern Cyprus and Famagusta, which has earthquake risk, as seen in Fig. 9.

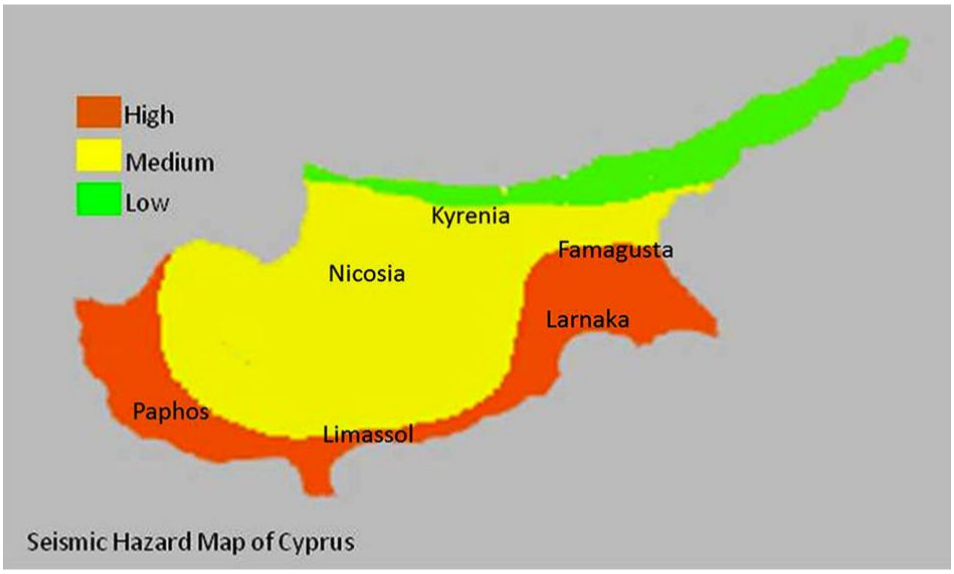

Fig. 9. Earthquake zones of Cyprus (redrawn by ……., Eurocodes Committee 2004)

Thus, for the evaluation of the case-study building from the point of view of structures, the following factors can be considered according to the Turkish building code:

- Structural system selection,
- Spatial dimensions,
- Number of floors,
- Plan arrangement,
- Arrangement of openings,
- Use of cross-walls and buttresses,
- Floor and roof systems.

The foundations of the building are renewed as reinforced concrete foundations, which is acceptable according to the Turkish building code. A masonry system that has stone walls with reinforced concrete horizontal tie-beams is selected as the structural system, and both the present structure and the renewed parts were built with this system. According to the Turkish building code, this system is acceptable if there is earthquake risk. Having a wall thickness of 40 cm on the second floor is not acceptable according to Turkish building codes, which suggests minimum of 50 cm. Yet, the spatial dimensions, number of floors, plan arrangement and arrangement of openings do not create any problems. The building does not contain any cross-walls or buttresses, which is not obligatory according to the code. The timber floor and roof system has been replaced with a steel floor and roof system. The Turkish building code does not make any restrictions about the selection of floor and roof systems in stone masonry structures. Consequently, it can be stated that the case-study building's restoration decisions about structure are generally acceptable, with the exception of the thickness of the walls on the second floor.

5. Guidelines for Adapting Historic Stone Masonry Houses to Contemporary Needs

Guidelines for adapting historic stone masonry houses to contemporary needs should consider conservation ethics and the building code that is being used in the considered country simultaneously. Because this article focuses on the conservation areas in Northern Cyprus, Turkish building codes should be considered. Conservation ethics consider historical values, whereas the ethics of making structural interventions consider the safety of future users as the main value. This article suggests giving priority to the requirement of safety if there is any contradiction between the two ethics.

The case-study building above was a semi-ruined building before its restoration. However, there are intact and ruined buildings within conservation areas. Some buildings might require additional vertical supports and completely new floor and roof systems, as seen in Fig. 10. The ethical suggestion for making interventions in ruined buildings should be different than the suggestions for intact buildings.

Fig. 10. General view of a ruined building in walled city of Famagusta (Photos by ……)

Thus, the guideline should consider the following issues:
- Whether the building is intact or ruined,
- The presence of seismic risk,
- Values to consider,
- The subject of the structural decision.

Table 4 presents the guideline for adapting historic stone masonry houses to contemporary needs for Northern Cyprus.

Table 4 Guidelines for adapting historic stone masonry houses to contemporary needs for Northern Cyprus

Subject of structural decision	Intact building		Ruined building		Values
	No seismic risk (A)	High seismic risk (B)	No seismic risk (C)	High seismic risk (D)	
Possible structural systems	-Stone masonry with steel horizontal tie-beams and RC foundations, -Stone masonry with white RC horizontal tie-beams and RC foundations.	-Stone masonry with steel horizontal and vertical tie-beams and RC foundations, -Stone masonry with white RC horizontal and vertical tie-beams and RC foundations.	-Stone masonry with steel horizontal tie-beams and RC foundations, -Stone masonry with white RC horizontal tie-beams and RC foundations, -Stone masonry with steel horizontal and vertical tie-beams together with steel frame, -Stone masonry with white RC horizontal and vertical tie-beams together with white RC frame.	-Stone masonry with steel horizontal and vertical tie-beams and RC foundations, -Stone masonry with white RC horizontal and vertical tie-beams and RC foundations, -Stone masonry with steel horizontal and vertical tie-beams together with steel frame, -Stone masonry with white RC horizontal and vertical tie-beams together with white RC frame.	Safety value + Conservation value
Spatial dimensions in plan	Try to keep original spatial dimensions, which cannot exceed 7.5 metres.	Try to keep original spatial dimensions, which cannot exceed 16 metres.	Try to keep original spatial dimensions, which cannot exceed 7.5 metres for 1 and 2 and 16 metres for 3 and 4.	Try to keep original spatial dimensions, which cannot exceed 16 metres for 1 and 2, 20 metres for 3 and 16 metres for 4.	Safety value + Conservation value
Number of floors	Original height will be kept.	Original height will be kept.	Try to retain the original height, which cannot be more than 4 floors for cut stone.	Try to retain the original height, which cannot be more than 2 floors for cut stone.	Safety value + Conservation value
Plan arrangement	Original plan arrangement will be kept.	Original plan arrangement will be kept if it is either symmetrical or structurally balanced.	Original spatial division will be retained. Continuous spaces can be achieved.	Original plan arrangement will be retained if it is either symmetrical or structurally balanced. Continuous spaces can be achieved.	Safety value + Conservation value
Arrangement of openings	Original openings should be reached, which cannot exceed the following limits:	Original openings should be reached, which cannot exceed the following limits:	Original openings should be reached, which cannot exceed the following limits:	Original openings should be reached, which cannot exceed the following limits: -like (B) for 1 and 2.	Safety value + Conservation value

	-maximum 40% of wall length, -minimum 1 metre away from the corners, -minimum 0.5 metre away from the wall intersections, -minimum 0.8 metre between openings, -maximum 3 metres long openings.	-maximum 60% of wall length, -minimum 1.5 metres away from the corners, -minimum 0.5 metre away from the wall intersections, -minimum 0.5 metre between openings, -maximum 3 metres long openings.	-like (A) for 1 and 2. -like (B) for the masonry parts of 3 and 4, unlimited for the frame parts of 3 and 4.	-like (B) for the masonry parts of 3 and 4, unlimited for the frame parts of 3 and 4.	
Use of cross-walls and buttresses	Cross-walls and buttresses in the original building should be kept.	Cross-walls and buttresses in the original building should be kept.	Cross-walls and buttresses in the original building should be kept.	Cross-walls and buttresses in the original building should be kept.	Conservation value
Floor and roof systems	Use of timber floor and roof systems as in the original.	Use of timber floor and roof systems as in the original and add additional horizontal steel elements if needed.	Use of timber floor and roof systems as in the original.	Use of timber floor and roof systems as in the original and add additional horizontal steel elements if needed.	Safety value + Conservation value
New structural elements and parts	Do not hide new structural parts. New parts should look new.	Do not hide new structural parts and elements. New parts and elements should look new.	Do not hide new structural parts and elements. New parts and elements should look new.	Do not hide new structural parts and elements. New parts and elements should look new.	Conservation value

The structural system selection row in Table 4 is prepared by considering that Turkish building codes accept use of stone masonry with horizontal reinforced concrete tie-beams in all seismic regions but encourages use of reinforced masonry in high risk seismic areas. Table 4 clearly demonstrates that neither conservation values nor structural values can be ignored during the restoration of small-scale stone masonry buildings in North Cyprus. It also becomes clear that the problem in the case study was about conservation values, not structural values.

Examination of Table 4 also shows that having no earthquake risk, allows the use of traditional materials in conservation projects whereas having earthquake risk lead the use of contemporary materials such as vertical steel tie-beams. Introduction of new materials and technologies can be considered as ethical in conservation only if it is inevitable and can be harmoniously integrated with the whole structure while it is distinguishable. Since risk naturally directs designers towards new technologies, this should be concerned as an ethical consideration.

6. Conclusions

This article asserts that conservation values and structural values are highly integrated and cannot be separated in the conservation projects of small-scale stone masonry buildings. If there is a contradiction between conservation and structure values, priority should be given to structural safety (not economy) as a value. The case study demonstrates that the domination of structural safety requirements can be harmful to the heritage values and authenticity of historic buildings.

Although large importance is given to structural safety values, the structural system is usually perceived as a given in restoration projects. This paper also states that given today's technology, structural system selection is the most important structural decision in the conservation projects of small-scale stone masonry buildings. Thus, it is healthy to prepare guidelines - for each type of structure and for each conservation area - containing both value systems in an integrated way.

This article contains guidelines for the conservation of small-scale stone masonry buildings in the conservation areas of Northern Cyprus. Today, with the increased rate of the development pressure, it is envisioned that the need for contemporary interventions within historic cities, especially for the walled city of Famagusta, will be accelerated in the near future. Therefore the laws and regulations should be updated according to the internationally accepted ethics of conservation and public awareness should be raised. The historic masonry structures located especially within the walled city of Famagusta, authors believe, are a part of the world heritage and require ethical approach towards its sustainable conservation in the long term. This paper aims at being a guideline both for the framework of legislative and implementation purposes considering the issue of structural system selection during restoration projects and for building codes containing recommendations about the restoration of historical buildings.

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