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Adaptive Reuse in Heritage Buildings of Mediterranean For the Implementation of Sustainable Development: Through Environmental Dimensions

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Abstract

Sustainability is one of the crucial tool fronts of the challenges like climate changes in 21st century. Sustainable developments deal with three dimensions or levels, which are; environment, society and economy. Adaptive reuse of buildings plays a key role in the sustainable development of the communities. It brings about environmental benefits significantly. Heritage buildings offer many advantages on the landscape, identity of the communities and amenity to the urban context. One of the main benefits of reusing buildings environmentally is the keeping of the building original “embodied energy”. By reusing the heritage buildings, the embodied energy of these building will be retained, hence, creating much more environmentally sustainable project, than new construction projects. New construction projects will have higher embodied energy costs than buildings that are adaptively re-used. Along with that, adaptive re-used of heritage buildings will save lands, money through financial saving returns and enhance the functionality of the existing buildings. The paper aims to reduce the impact of climate changes and reach better environment through the adaptive re-use in Heritage buildings. The quantitative method will be approached, and historical buildings as case study will be selected from North Cyprus, and the life cycle materials will be evaluated based on literature survey and theoretical analysis with the help of LEED rating system. Qualitative method through questioning of expert people will be approached too. Comparison between the findings from both ways will be carried out and the result will be extrapolated. Different materials, techniques, and architectural strategies will be analyzed and recommended, based on their impacts on the environment for optimizing the environmental effects of these buildings. The results retrying to reach a comprehensive understanding about the efficiency of adaptive re-use methods for the heritage buildings simultaneously with the climatic characteristic, and establish guidelines for that.

Keywords: Historical building conservation; ‘Adaptive re-use’, Sustainability, Sustainable materials, LEED.

1. Introduction

Forty years ago, the relationship between heritage and urban development was discussed and the importance of heritage buildings within the urban context was highlighted. In the ICOMOS conference on ‘The Protection of Historical Cities and Historical Quarters in the Framework of Urban Development’-Moscow and Suzdal- Russia in 1978). The first time the introduction for the concept of Sustainable Development with three main aspects economic, environmental, and social development occurred in the Brundtland Commission of 1987. United Nations Conference on Environment & Development AGENDA 21 1992, a global action plan for sustainable development in the 21st century eventually led to the ratification of Agenda 21 for Culture 2004, promoting the implementation of a “cultural impact assessment.” The World Heritage Convention in Kyoto ‘2012’ (UNESCO, 2012), emphasized for the first time on that a need for research on the role of heritage in sustainable development and a necessity to identify performance indicators was decided (ICOMOS, 2011). According to UN publication in 2009, on the effect of buildings on climate change, “buildings are responsible for more than 40 percent of global energy use and one third of global greenhouse gas emissions, both in developed and developing countries.” UNEP, 2009, p. 9). Thus, retrofitting and improving energy efficiency in buildings is an emergency and significant way of reducing the crisis of environment. When the aim of sustainable building practices is reducing environmental impact, it is rational to suppose that the adaptive reuse and improved energy performance of historic buildings can have a key role in sustainability (Urge-Vorsatz, et al., 2012). A great part of heritage buildings is built with especial attention given to local climate and often take advantage of the environment, in other words, they were designed and constructed based on bioclimatic principles. Furthermore, many heritage buildings are built of durable and local materials such as masonry stone, wood and adobe, which have long life and can last hundreds of years and commonly, offer advantages such as

inherent climatic durability and lower transportation requirements. Moreover, these materials known by low 'Embodied Energy'¹ than contemporary materials such as glass, steel etc.

One of the main benefits of reusing buildings environmentally is the keeping of the building original 'embodied energy'. By reusing the heritage buildings, the embodied energy of these building will be retained, hence, creating much more environmentally sustainable project, than new construction projects. New construction projects will have higher embodied energy costs than buildings that are adaptively reused. Along with that, adaptive reused of heritage buildings will save lands, money through financial saving returns and enhance the functionality of the existing buildings.

2. Historical Building Conservation

Heritage buildings are part of the man-made environment, which provides symbols for a nation, local identity mirrors the social value and social foundation, and it is a source of memory. Furthermore, historical sites are one of the interested destinations by a human in all around the world, which leads to stimulate the tourism business industry in those areas which have these historical and heritage buildings (Binhasbollah, 2015).



Figure 1. **Bellapais Monastery in Kyrenia, Northern Cyprus.** URL2

The Conservation can be defined as the procedures of taking care of a place in order to hold its cultural significance. Conservation consists of several methods of maintenance as per its condition. the methods could be utilized in saving historical buildings extend from Restoration, Rehabilitation, Remediation, as well as Adaptive re-use, and many others which usually be a mix of more than one of these methods. Each activity has its own technique and system, and all these methods named under conservation of historical buildings since they are ways of conserving historical buildings. Because of the significance and importance got from history, we have to conserve historical buildings.

"Restoration" refers to, the process of conservation which is dealing with the responding to the historical image of the building (Bradshaw, 1995; Golmakani, 2011). "Rehabilitation" known as; the process of returning a thing to its previous condition or status, and it is dealing with the practical elements which are made to the functional needs of the building (Bradshaw, 1995; Golmakani, 2011). The term 'Remediation' according to Bradshaw, (1995) is the process of remedying. It is "to rectify, to make good" (Bradshaw, 1995, p. 3).

"Reconstruction" is defined as the act or process of drawing, through of new construction, the features, the form and detailing of a site, landscape, building, structure, or object for the purpose of re-produce its appearance at a particular period of time and in its historic location (Kareeva and Glazkova, 2017). The concept of Adaptive re-use is another significant way in conservation processes which will be concerned in this research.

2.1 Adaptive reuse

Adaptive re-use is one of the most widely used methods for the survival of historical buildings (Casal, 2007). Bromley *et al.* (2005) addressed that adaptive re-use is basically a shape of heritage and historical conservation in buildings. Adaptation of historical buildings into new functions and conserving them participate directly to growth of the community (Latham, 2000; Wilkinson *et al.*, 2009), conserve their historical significance and leading to minimize the impact on the environment without the need to construct new one and use it for specific function through using the

¹ the energy consumed by all of the processes associated with the production of a building, from the acquisition of natural resources to product delivery, including mining, manufacturing of materials and equipment, transport and administrative functions.

same building, which means less embodied energy consumption (the energy that used in the process of construction) (Fitch, 1990; Rameshaet *al.*, 2010). See figure '2'.



Figure 2. The Lantern, a glass atrium that sits atop the entrance to the Canadian Museum of Nature in Ontario. URL1

The value of historical building in adaptive reuse is a re-use with the new functions determined by preserving the authentic character in the building, bringing the past and the new architectural understanding together, although the structures are used at different times in history (Plevoets and Van Cleempoel, 2011). Adaptive re-use is one of the effective strategies to preserve the values for the building and also extend the life of the building through using it with alternative function or same function, to prevent the buildings to be demolished (Ball, 2002; Bullen and Love, 2010; Jokilehto, 2006).

According to Akhtarkavan, *et al.*, (2008), the advantages of adaptive reuse for the sustainability can be enumerated as; a. reduce energy consumption b. Reuse the existing materials c. reduce environmental impacts d. reduce land mitigation through using the same sites e. Reducing construction waste f. Accommodating human needs g. Meeting performance requirements h. conserving architectural elements i. Reviving urban areas j. developing the economic features k. reducing the time for new construction l. Maintaining traditional identity.

2.2 Sustainability

To control the global warming and climatic changes, which is a challenge for the World's future, needs to apply sustainability to solve the recent problems. High population and the growth of cities lead to increase the construction of buildings. Furthermore, the future generations quality of life should not be affected negatively. To achieve this goal there is essential needs to control design and construction of buildings, and urban design. Therefore, in design and construction stages sustainability became very important to save the natural resources for next generations. The first definition for sustainability have been determined in 1987².

However, building construction is a significant factor for damaging the environment damage by exhausting conventional sources, damaging natural and eco areas, increment of pollution and the use of building materials which are harmful to human health. Sustainability consists of three main levels interrelated among each other to crystallize the sustainability. Sustainability have been known by developing three aspects; environmental, economic, social (Adams, 2006). The presence of these aspects in any field are important to implement sustainability. See figure '3'.

² United Nations World Commission on Environment and Development (UNWCED), in 1987, defined sustainability as “*meets the needs of the present without compromising the ability of future generations to meet their own needs*” (Al Surf, 2014).

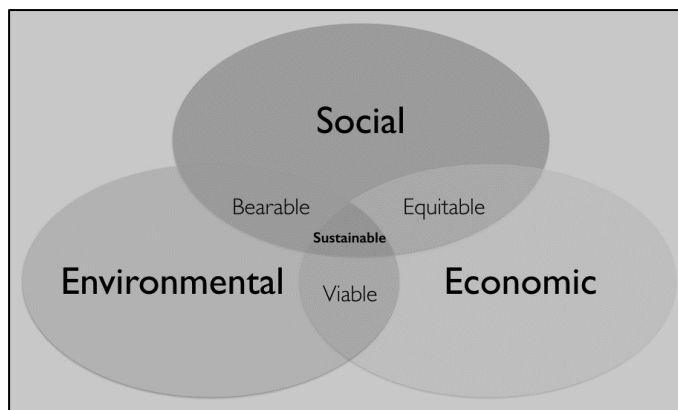


Figure 3. The three terms constitute the concept of sustainability. URL2.

3. Problems of the study

The construction of new buildings leads to consume considerable amounts of raw materials, as well as land properties which, could be used in other ways. The enormous increment of energy usage in the world gives a warning about depleting energy sources and severe effects on the environment (global warming and climate change, etc.). According to “United Nation’s Environment Programme” (2009), buildings consumes about 40% of global energy, 40% of global resources, 25% of global water, and they emit approximately 30% of GHG (Green House Gases) to the atmosphere (Ozdil, 2010). Thus, according to an ecological architecture opinion, building design should be eco-friendly or environmentally friendly to overcome these environmental crises.

Sustainability is one of the crucial tool fronts of the challenges like climate changes in 21st century. Sustainable developments deal with three dimensions or levels, which are environment, society and economy. Adaptive reuse of buildings plays a key role in the sustainable development of the communities, which brings about environmental benefits significantly. Heritage buildings offer many advantages on the landscape, identity of the communities and amenity to the urban context.

The paper aims to reduce the impact of climate changes and reach better environment through the adaptive reuse in Heritage buildings.

Since the aim of sustainable building practices is often described as strategies implemented to reduce environmental impact, it is important to suppose that through adaptive reuse and retrofitting energy usage in heritage buildings the sustainability can be implemented.

Hence, building design should ensure that constructions and actions of today would not compromise the right of future generations’ opportunities to use the earth resources (Burton, 2012). Sustainable certification considers a significant factor for enhancing efficiency in energy consumption, the quality of environment, controlling the depletion of non-renewable resources, and design development. It is allowing more facilities on energy consumption and management of the buildings environmentally, economically, and socially. The consumption of materials and depletion of land can be decreased through adaptive reuse of existing buildings instead of replacing and demolition/reconstruction processes. Adaptive reuse focus on the changing in the original function of historical buildings without demolishing them or reconstruct them from zero. This way of conservation processes, depend significantly on the ways of design elements, through creating different inner environment without affecting historical value in the building. Commonly, demolition is unnecessary when older buildings can cost-effectively be adapted to current uses, where, existing buildings can be made sustainable, and reduce energy consumption through built environment.

However, universal procedures and guidelines with specific recommendations have not yet been developed to take full advantage of built heritage in sustainable development. Nor has there been procedural measures introduced to ensure that heritage conservation and management policies support sustainable development goals.

The research tries to answer the following questions; whether or not adaptive reuse of heritage buildings influence environment effectively? And is the climate characteristic will drive a role in influence? What are the most environmental effective factors to be considered in the adaptive reuse for the heritage buildings?

The main objectives in this research are; evaluate the retention of embodied energy by adaptive re-use of heritage buildings compared with new construction; determine the environmental benefit of adaptive reuse of heritage buildings method and the influence on climate change.

To assess the validity of sustainability in adaptive reuse buildings, and identify LEED rating system checklist for evaluating adaptive reuse buildings, in terms of Sustainability.

The study will investigate the inclusion of “environmental sustainability” in the evaluation criterion of heritage building, looking at sustainability rating systems used to evaluate sustainable urban development. The study will argue that a similar approach to what architects and urban developers are using can be designed to assess heritage buildings in order to rate their sustainability, with the intention to use the result to show how the reuse of heritage building can help nations get closer to achieving of sustainability goals.

Usually in the paper a hypothesis (prediction) is needed to be crystallized to identify what kind of variables are should be examined and how they could be they can be evaluated or controlled. The study hypothesizes that, if adaptive reuse applied on the heritage buildings, then climate changes impact will be reduced, and more sustainable community will be created.

4. Methodology

To conduct the hypothesis in this research quantitative and qualitative method will be approached. Case studies will be selected from Mediterranean regions, especially Northern Cyprus. Embodied energy, will be evaluated and the life cycle materials will be evaluated based on literature survey and theoretical analysis. Questionnaire will be designed to ask the opinion of experts about the validity and potential of adaptive re-use method in the case study building. Then a comparison between the findings from both ways will be carried out. LEED rating system will be applied in order to evaluate the energy consumption during the conservation process. See figure ‘1’.

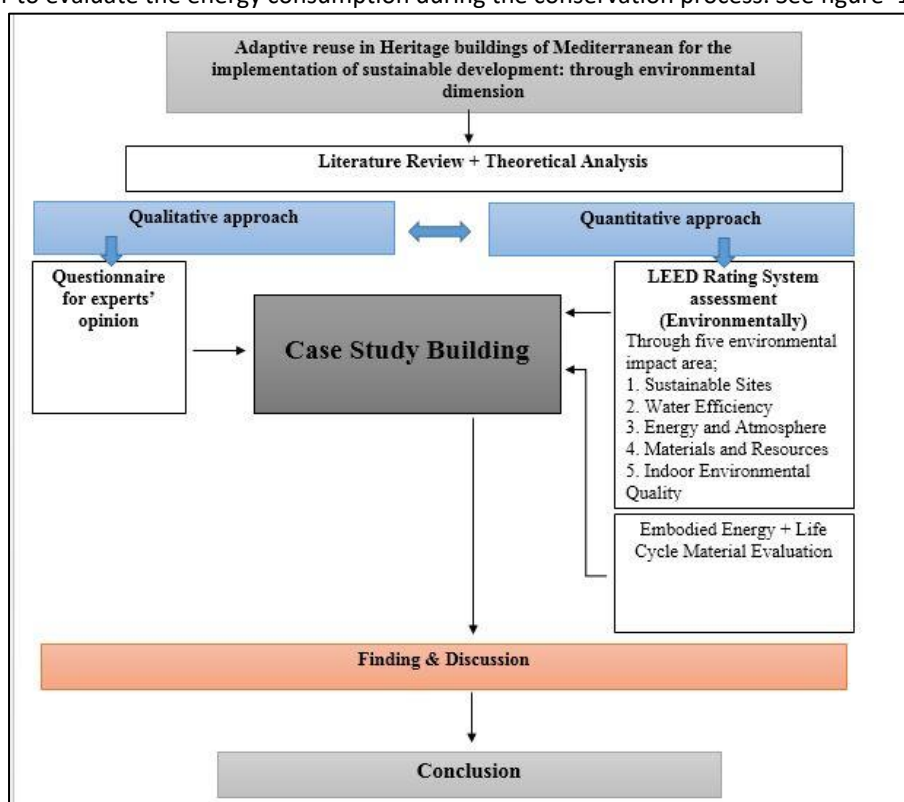


Figure 4. Methodology Outline.

LEED is environmental assessment system implementation in buildings during all the life of the building, to evaluate the ‘green building’ degree (DOE, 2001). (Kirk and Dell’Isola, 1995) shown that based on USGBC, the necessity behind the finding LEED was;

1. Provide a positive influence on environment, occupants’ health and reduce the daily cost.
2. Formulate the guidelines for assessment of meaning of “green”
3. Avoid “washing of green”
4. Promote design process in buildings.

LEED green system consists of five main environmental impact area plus the sixth impact which calls ‘Innovation and Design Process (ID)’. The five environmental impact area are divided as; 1) Sustainable Sites (SS); 2) Water Efficiency (WE); 3) Energy and Atmosphere (EA); 4) Materials and Resources (MR); 5) Indoor Environmental Quality (IEQ). The sixth factor is not concerning directly to the environmental dimension, but economic and social. The total credits of LEED rating system are 69 credits divided on the impact areas. Four of the impact areas have prerequisites; these prerequisites are compulsory and required in every building, (DOE, 2001). See table ‘1’.

Table 1. LEED Green Rating System checklist and credit system.

No	Area	No. of Credits	prerequisites
1	Sustainable Sites (SS)	14	1 required
2	Water Efficiency (WE)	5	
3	Energy and Atmosphere (EA)	17	3 requires
4	Materials and Resources (MR)	13	1 required
5	Indoor Environmental Quality (IEQ).	15	2 requires
6	'Innovation and Design Process (ID)'	5	
		Total= 69	Total= 7

Some of the credits have several layers to increase the execution accomplishments. Keeping in mind to get a LEED Certification, 26 points should be earned and all prerequisites should be achieved. The grades of LEED rating is as shown;

1. 'Silver rating'; (33 to 38) points must be earned.
2. 'Gold rating'; (39 to 51) points must be earned.
3. 'Platinum rating'; (52 to 69) points must be earned, (DOE, 2001).

Although there are many different rating systems available universally, LEED is well known and accepted worldwide and can provide valuable insight in evaluating sustainability.

4.1. Methodology Phases

The paper will have several phases in order to reach the credible results. Figure '2', demonstrates the phases of this thesis with brief explanation for each phase.

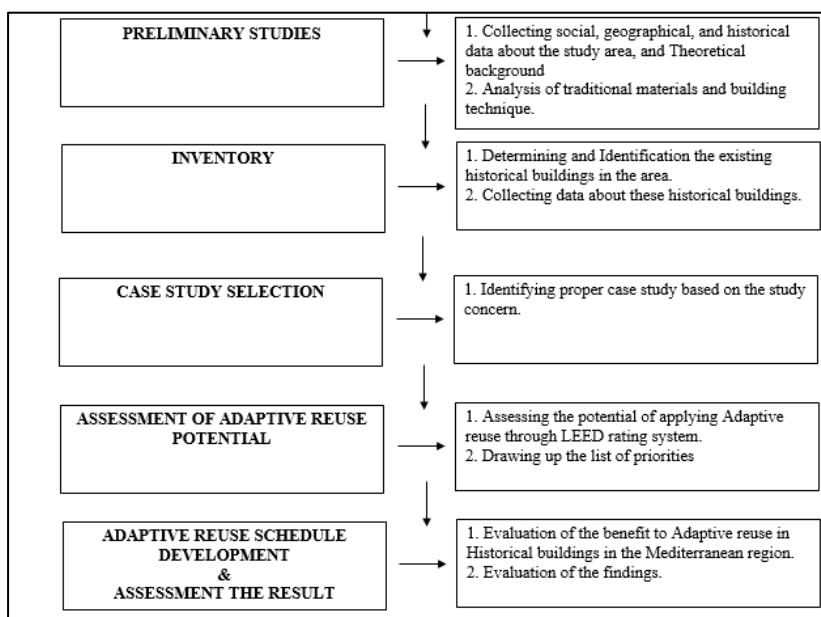


Figure 5. Structure of the paper.

5. Discussions

Different materials, techniques, and architectural strategies will be recommended, based on their impacts on the environment for optimizing the environmental effects of these buildings. The principles of sustainability will be taken as a guide to be analyzed.

The main principles of sustainable houses are; implementing comfort for users of the buildings, and safety for around circumstance. (ZainulAbidin andPasquire, 2005). Buildings and constructions, involves into socio-economic development deeply and makes significant use of the resources in nature and affects the greenhouse gasses production by buildings (Asif *et al.*, 2005). The principle aims for saving the rights of new generations without compromising the right of this generation. There are several principles of sustainable building applied around the world. In environmental dimension, are:

1. Apply energy efficiency in the buildings through the optimum orientation, optimum sun incidence into the buildings, introducing ventilation, natural lighting into the building, and use new technologies in building services such as renewable energy applications.
2. Ensure good indoor air quality with achieving thermal, visual, as well as acoustic comfort into the building. This will include low volatile organic compounds usage, inner air filtration, and proper humidity.
3. Selecting a proper site with the accessibility to public transport, services, and open space.
4. Choosing materials that have low impact on the environment and human.
5. Rainwater harvesting, recycling the water and water system equipment.

In other dimensions such as social and economic dimensions, assuring social equity and affordability in the buildings are the main points to achieve sustainable design principles in buildings (Sani and Chi munaaaim, 2012).

In addition to sustainability principles in the buildings, there are several features in building material, which make it sustainable, then should be taken in consideration during the analysis. Some of these features will be explained in this part;

1. The *embodied energy of a material* is the whole energy requested to manufacture that material, beginning from the raw condition of material's collection. This includes all type of the energy used to power the collecting equipment, and the manufacturing operation process. as well as the transportation equipment which transfer the raw material to the construction process. The result of this procedure will cause combustion of fossil fuel that consider as conventional resource and non-renewable. In addition, has negative impact on the environment through emission the gases to the atmosphere, and cause localized smog, acid rain, global warming, and climate changes (Minke, 2006). The greater embodied energy in the materials, indicate more amount of energy required to produce it, then the greater impact on the environment. Thus, the natural local materials have less embodied energy than manufactured ones.

For example, the production of adobe bricks (shaped clay and dried naturally) in a sustainable vision needs consuming lower energy and create less pollution in compare with the concrete block manufacturing which contain cement (high polluted material) as one of the components in production of this material.

2. *Energy efficiency of a material* is a significant feature to make a building sustainable. The aim behind supply materials with low energy consumption because they increase energy efficiency of the materials that use in a construction site. The cost of energy thorough out the life of the building is extremely related with the applied materials in the building. The efficiency of the construction building materials can be accessed through evaluating heat transferee coefficient value of these materials. The materials with high heat transfer coefficient value (u-value), within the skin of buildings, require less consumption of energy for thermal comfort maintenance (Koenigsberger, *et al.*, 2010). Coefficient value of shadings, luminous rating efficiency, or the efficiency of fuel, is other factors. Quantify and evaluate a building material's efficiency can be conducted in order to help in the comparison and selection of building materials and determining the optimum for building.

3. *Non- or less-toxic components in the materials* are the materials with less impact on the works and occupant's health. Where, toxic materials affect IAQ and let the buildings occupants 'in healthy trouble. Some building materials like sticky materials are spreading risky emission for short period after the fixing. Whereas, other types of materials as paintings or some type of building materials (Asbestos sewerage pipes) could affect the health of users throughout the building's life (Jin Kim, 1998).

4. *Durable or Long-life material* is the material which requires less frequent replacement, then reduces the cost of replacement and re-installation. These kinds of materials are sustainable because, will need raw materials less than before, and create less waste within the time of the building's life (American Institute of Architects, 1992).

5. *Low- cost or cost- efficient materials* are the materials that achieve the economical dimension in sustainability. Use of low-cost building materials for construction could leads to implement low cost building, which increases the access to buildings by low income group peoples (Ilberg, and Rollins, 2007).

The environmental sustainability assessment criteria established in this study to be field tested based on LEED rating system to reveal its strengths and weaknesses in actual application. Testing the system have been applied on historic building case study in NTRC. The information gathered from interviewing local architects, architecture historians, government officials, staff members and other local stakeholders in NTRC.

6. Conclusions

The results endeavor to reach a comprehensive understanding about the efficiency of adaptive reuse methods of conservation for the heritage buildings in Mediterranean area simultaneously with the Mediterranean climatic characteristic.

The obtained results from assessment criteria introduced in this paper are a "prototype" to test out a concept. To achieve the goal of refining the concept into a globally workable and contextually adaptable framework, much more research is necessary. The main aim of this research is to demonstrate the potentiality of the LEED rating system as

a way of collecting data to provide objective assessment of Adaptive reuse heritage buildings. The method could show that, if adaptive re-used heritage buildings were evaluated based on LEED rating system on their environmental sustainability performance, the result of the performance will demonstrate incorporation with the sustainability. The adaptive reuse could be demonstrating high cooperation with the environmental sustainability. The LEED rating system method would provide a useful tool in recognizing the amount of possible intervention required for the re-use, and help determine whether such use is compatible with the international goals of sustainability set by UNESCO.

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