

# Preserving of the embodied energy environmental sciences essay



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Conservation of heritage buildings generates very important benefits to the environment. A number of studies around the world have addressed this subject. Review of the literature revealed three main environmental benefits gained by conservation including: Reduction of hazardous materials; Preserving of the embodied energy; and Preserving of the Energy.

## **Reduction of Hazardous Materials**

Heritage buildings are more suitable for the environment because they have been built by using traditional materials such as mud, lime and stone.

Traditional materials are natural materials. Therefore, they do not cause any pollution of the environment and also its preparations do not affect the environment. Modern building materials are generally reliant on large scale industrial processes that can emit very substantial levels of " greenhouse gases", can require significant energy consumption and are often transported hundreds if not thousands of miles. For example the manufacture of cement alone accounts for 3% of " greenhouse gases" produced worldwide and the manufacture of PVC (Poly vinyl chloride) demands a lengthy process that requires a significant consumption of energy (Donough Cahill, 2004). A study carried out by De Sousa (2001), in the greater Toronto area, Canada found that the reduction of health risks posed by hazardous is the most important environmental benefits associated with Brownfield development. Moreover, vacant properties often contain an array of conditions such as illegal dumping, leaking, and fire hazards that pose serious threats to public health and the environment (Schilling, 2002).

## **Preserving of the Embodied Energy**

The retention of the original building's "embodied energy" is one of the main environmental benefits of reusing heritage buildings. Rypkema (2005) defined the term "embodied energy" as "the total expenditure of energy involved in the creation of the building and its constituent materials". The embodied energy can be also defined as "the embodied energy is the quantity of energy required by all activities associated with a production process, including the relative proportions consumed in all activities upstream to the acquisition of natural resources and the share of energy used in making equipment and other supporting functions, i. e. Direct plus indirect energy" (Treloar, 1997). Wishkoski (2006) gives an example: a heritage building with approximately 308,000 exterior bricks, each with an embodied energy value of 14,300 Thermal Units (BTU), represents 4.4 million BTUs of energy expended in the original construction of the building, or 1.3 million kilowatt hours of electricity. Planners, architects, investors, and public officials must take into consideration the energy used in the production and assembly of materials needed for new buildings, from their origin to their end of life and subsequent reuse. Conservation causes much less destruction of the natural resources than new construction. Statistics reveal that building construction consumes 40 percent of the raw materials entering the global economy every year (Bahl, 2005). Interestingly, about 85 percent of the total embodied energy in materials is used in their production and transportation (Bahl, 2005). In Australia, studies showed new buildings have much higher energy costs than buildings that are conserved. In 2001, new buildings accounted for 25 percent of wood harvest, 16 percent of fresh water supplied, 44 % of landfill, and 45 % of carbon dioxide production and <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>

up to half of the total greenhouse emissions from industrialised countries (Australian Department of the Environment and Heritage, 2004). Besides that, demolition of buildings causes environmental loads. Whereby, the large volumes of construction waste strain landfill capacities and leads to environmental concerns. Therefore, conservation of the heritage buildings is the best resolution for this issue. Rypkema (2005) argues, the process of demolishing a historic building has a significant impact on the environment. When a building is being demolished, first, tens of thousands of dollars of embodied energy are being thrown away. Second, it is being replaced with materials vastly more consumptive of energy. Furthermore, modern construction methods are incredibly wasteful of resources. Studies show that Up to 25 percent of the total waste generated in the USA and other countries is directly attributed to building, construction, and demolition activities (Bahl, 2005). These waste products can be environmentally hazardous and polluting, both as solids and in the atmosphere. The waster also stresses the capacity of landfill sites.

## **Preserving of the Energy**

Preserving of energy is a great advantage that can be gained from conservation of heritage buildings. The old construction methods were used with taking into consideration to keep the weather out without consuming energy, namely, keeping the heritage building cooling in summer and heating in winter. When a heritage building is preserved or restored, those old cultural methods are preserved and brought back to active duty. Very likely, the old building was strategically placed to get the best orientation to the sun to make the most use of the solar energy, and the interior space and

its openings were efficiently organised to keep the air circulating and cool down the space without using any sort of air conditioning and electricity. Preserving a heritage building helps avoid the consumption of additional energy by getting advantage of the old construction methods designed to cool and heat the space and keep the weather out without energy consumption (Stas, 2007).

### **2. 6. 3 Social Benefits**

Conservation of heritage buildings entails significant social benefits. Those benefits can be categorised under (1) Job creation, (2) Crime reduction, and (3) The sense of place factor (Stas, 2007). Social benefits can be summarised as follows.

#### **Job Creation**

One of the social benefits for the conservation of heritage building is job creation. According to Rypkema (1999), investing in vacant properties is an important tool that creates new job opportunities in communities and urban centres. The labour intensity of building conservation generally means that there is a greater local economic impact in jobs and income than with the same amount spent on new construction.

#### **Crime Reduction**

Abandoned heritage buildings can quickly become havens for vandals, homeless, arsonists, and drug dealers, and as a result drive down property values, taxes, and services, and discourage investment in a community. Schilling (2002) describes the effect of abandoned buildings on communities as a disease that once started it can quickly spread throughout a

neighbourhood. The residents often felt unsafe walking on streets that have abandoned buildings. Local governments may succeed conserving one building but often do not have sufficient resources to keep the demand of a growing number of vacant properties. Some property owners feel helpless in trying to recruit new tenants. Property owners become less interested in investing in these neighbourhoods. Many residents eventually leave while those who remain become accustomed to blight as the neighbourhood deteriorates. This cycle continues with each new pocket of vacant and abandoned properties (Schilling, 2002). In contrast, by conserving those vacant properties for another use, the illegal activities that used to occur in those properties will be eliminated, which will bring peace and safety back to the neighbourhood.

### **The Sense of Place Factor**

The built and natural environments are elements that express the distinctiveness of a community or a neighbourhood. Rypkema (1999) wrote about the sense of community and ownership: " A sense of ownership acknowledges an individual benefit from, an individual stake in, and an individual responsibility for one's place. A sense of community acknowledges the obligations to and interconnectedness with the other residents of that place" (Rypkema, 1999). Deteriorated vacant buildings affect the identity of the community and drive residents to lose their sense of community ownership. This does not mean the ownership in a legal sense, but ownership in its broad meaning, where individuals acknowledge their responsibility and obligations for one's place and for other residents of that place.

## **2. 7 The Effect of Heritage Conservation on Property Value**

The relationship between heritage conservation and the economic value of the properties was examined by the economics literature. Prior research reported a positive effect of heritage districting on property values. Other studies have been inconclusive, or have documented some negative effects, but the weight of evidence is toward positive effects. Rypkema (1994) cited evidence from Canada and found that, in every heritage district designated in Canada in the last 20 years, property values have risen despite the fact that development potential has been reduced. A study by New York City's Independent Budget Office examined the effect of the local heritage district designation and regulation of real-estate prices and found evidence of a statistically significant price premium associated with the inclusion of a property in a heritage district. The extent of the premium varied from year to year, ranging from 22. 6% to 71. 8% (New York City Independent Budget Office, 2003).

## **2. 8 Past Studies on the Old City of Ghadames**

There is a significant lack of studies conducted in the old city of Ghadames. Even though few studies were done in the old city and the modern city of Ghadames; however, there is a lack of studies addressed the issue of the conservation of heritage buildings. Additionally, none of them attempted to develop guidelines for conserving heritage buildings in the old city of Ghadames. Some research studies were carried out by Chojnacki, (2003); Elwefati, (2007); and Nura, (2006). Chojnacki (2003) has presented research comprising a comparison of features between traditional and contemporary housing in the desert zone on the example of the city of Ghadames in Libya.

The rationale behind the comparison of the microclimate prevailing in traditional and modern homes comes down to highlighting the enormous differences between the two, the poor adjustment of contemporary solutions to the conditions imposed by the natural environment, and the inability to achieve proper microclimatic conditions without using products of advanced technology. The comparison of the features of traditional and modern housing provides a method of assessing the microclimate conditions in those housing systems as a measurement of the quality of life of the residents. Suggestions were also made concerning the ways of controlling and improving the microclimate in the contemporary housing of the desert zones, as well as presenting and disseminating the research findings. Other research by Elwefati, (2007) aimed to investigate the bio-climatic characteristics of traditional and contemporary residential architecture in three different climatic/geographical regions of Libya, which were represented by Tripoli in the " coastal region"; Gharyan in the " mountainous region"; and Ghadames in the " desert region". It was undertaken to understand and evaluate the effects of building layout and orientation, wall thicknesses, ceiling height, construction materials, thermal mass and size of windows, on the resultant thermal comfort conditions of the buildings/dwellings in question. An architectural survey of the dwellings was carried out and indoor and outdoor photos of houses were taken. Temperature and humidity data in pre-determined rooms of the dwellings, in addition to data relevant to exterior weather conditions were recorded by thermo-hygrometers. Residents who had experience of living in both traditional and contemporary dwellings were interviewed informally before preparing a comprehensive questionnaire, which was distributed to them to <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>



gather the required data. It was found that traditional dwellings in Tripoli and Ghadames, in their present condition, did not provide the desired level of thermal comfort. This was attributed to a number of reasons. One was the abandonment of these dwellings by their occupants, in favour of those of modern style. The resulting collapse of some parts of adjacent house blocks, which used to provide a degree of protection against climatic conditions when working as a whole block of several attached houses. Another was the introduction of new construction materials that were incompatible with the original ones. However, traditional dwellings in both cities appeared to provide relatively better thermal comfort conditions in comparison with the use contemporary dwellings of recent years, except for those with air conditioning. This situation was different in Gharyan, where the troglodyte dwellings were concerned. These dwellings were thermally more comfortable than the modern ones in the city. This was attributed to the fact that most of the existing troglodyte dwellings still preserved their original features to a large extent. At length, this study recommends that modern types of dwellings should adapt those features of the traditional ones that are most compatible and suitable for the local climatic conditions, in a way which guarantees optimum exploitation of local resources in terms of energy consumption and cost. In addition, Nura et. al. (2006) have presented a study of the housing and the environmental requirements for desert housing in Libya (Ghadames old and new town). The study covers the traditional and modern houses in Ghadames, and also includes a review of previous studies on the same topic, and reviewing the problems and solutions. Their study has identified the solutions of desert housing problems in Libya, and found the reasons why people migrate from the new town to the old town and <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>

other cities near the coastal area during the summer time. A suitable solution for the desert housing problems that will suit the environment is to find a proper design for the desert houses which is affordable and environmentally responsive, including the proper materials that can be used to build the deserted houses such as the combination of the natural materials and the new materials, and to propose suitable desert development. Nura et. al. (2006) research can be divided into theoretical and practical parts. The theoretical part involves the identification of crucial issues through theoretical background such as literature and interviews theoretical. This background offered a realistic approach in gathering three kinds of information for the subject, first of all a closer look at a necessarily range of matters which has brought about desert housing problems in Libya, secondly a deeper study of issues, which is in the proposal formulated to important aspects of the problem, thirdly an application as a main output of the previous information. The practical part was focused on Ghadames; the study showed the problems of the desert housing in this area and proposed solutions to overcome these problems.

## **2. 9 Conservation Programmes Conducted on the Old City of Ghadames**

Conservation programmes conducted on heritage buildings of the old city of Ghadames are very few. According to Arrabti, (2011) and Al-Hasi, (2011), there is only one conservation programme executed and implemented by the United Nations Development Programme (UNDP) and the UNDP Office for Project Services (UNOPS). The project is titled with " Rehabilitation of the old town of Ghadames". The project was started on the 1st of April, 2000 and

ended on the 1st of April, 2004. The total cost of the project was USD 5, 494, 038, and financed by Libyan government. According to the United Nations Development Programme and the UNDP Office for Project Services Report (2007), the project implemented a comprehensive action plan for the rehabilitation of the old city of Ghadames. The objectives of the project were as follows. To revive the natural source of water that forms the life support of a desert oasis (Ain Alfaras) and the water distribution system provision of water of the homes and sanitation. To re-cycle of wastewater for agricultural purposes. To revitalise the orchards and farming production system in the area adjacent to the old city. To renovate and rehabilitate of adobe structures. To promote a greater tourism service level through training and a better international recognition of Ghadames in its historical setting, and revitalise traditional handicrafts production to promote women's income. The project carried out the rebuilding of private houses by local residents, renovating water works, revitalising agriculture, and improving tourist services by using local building materials such as bricks, lime, palm tree trunks and fronds. Workers had used locally quarried gypsum for replastering, and adobe bricks and palm trunks and branches for walls and roofs. In addition to improving the community's quality of life, the project aimed at preserving cultural traditions and local knowledge, whilst at the same time promoting tourism and economic diversification. Furthermore, the project has raised footpaths that serve small fields within the old town oasis. In addition, the project team had carried out hydrological and geological studies of the spring to analyse how to rehabilitate it. Over the centuries the people of Ghadames had developed an intricate network of canals fed by the spring, carrying water throughout the old town and its fields. The project was <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>

divided into two phases. The first phase was completed in 18 months and it focused on the following aspects: The rehabilitation of the water source system. Assessment of available building material and structures and the formulation of a participatory capacity building program for the training of 10 work teams to undertake renovation activities. Forging agreements with tour offices and the Ministry of Tourism for a more equitable share of tourism revenue to be designated for the preservation of the old city. Rehabilitation of the handicraft industry and strengthening the role of women in its revival. The second phase was completed in 36 months. It focused on rehabilitation of farms and improvement of production efficiencies of farming systems and integrating of products with the tourism sector. The main beneficiaries from the project were the tourist sector (offices, guides, hotels some commercial establishments, handicraft traders, including women, and transportation), owners of the homes and farms in the old city, renovation workers and supplier of building material. Preservation of such a national heritage is of special importance to the Libyan image in preserving a unique culture (United Nations Development Programme and the UNDP Office for Project Services Report, 2007). According to the United Nations Development Programme and the UNDP Office for Project Services Report, (2007), renovation and rehabilitation of adobe structures of the heritage buildings are one of the objectives executed by the rehabilitation program. To achieve this objective, a national consultant (civil engineer) who has experience in renovation of adobe structures as a trainer was appointed and 70 technicians and skilled labourers for on the job training program were selected. Ten technicians who have experience in renovation work at the old city of Ghadames were selected to train on survey of buildings for renovation <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>

needs and types of renovation material to be used. Available materials for renovation and the mixes to be used for the various repairs or reconstruction were reviewed. All 70 workers were participating in the preparation of various mixes and their use in the renovation activities. In addition, participatory sessions and field work days for owners of homes and older people who are familiar with the traditional methods of repair were conducted.

## **2. 10 Stages of Conservation of Heritage Buildings**

The process of conservation of heritage buildings comprises several main stages starting from studying the heritage area and collecting the data, and terminating with creation of plans and carrying out them. These stages are not separated but nested with each other. It is worth mentioning that stages of conservation of heritage buildings are not consistent, namely, they vary from a team to another. No consistent basis can be determined for evaluating the architectural, constructional or the heritage building condition but it depends on the views of the specialist team and their previous experiments. Accordingly, plan of conservation differs from the architectural plan for modern buildings because the conservation plan is subject to a series of international and local laws that insure preserving the historical value during the conservation process (Itma, 2007). The conservation practice involves several main stages. According to A Ghafar, (2009), the framework of heritage building conservation includes: Preliminary investigation, dilapidation survey, preparation of tender document, conservation works, and heritage management. Norlizaiha, (2011) defined three main stages in conservation practice including; documentation and

record, dilapidation survey and building investigation, and conservation works. In addition, Itma, (2007) mentioned that the first stage for conservation of heritage building is to gather all historical and architectural information about the heritage buildings. Second stage according to the researcher is to evaluate the current construction condition of the heritage building including evaluation of the architectural and historical condition of the heritage building. The third stage is to establish the proposed conservation plan. Based on the above, the heritage building conservation practice includes the following stages:

### **Stage One: Documentation**

Documentation includes two stages, historical research and measured drawing (Norlizaiha, 2011). Historical research should be conducted before starting any physical interventions. Its purpose is to collect all the available evidence of the heritage building such as previous historical reports, any old photographs, old maps, old paintings, drawings, etc. Measured drawing is used to illustrate the interior and exterior of a heritage building including the structural detail as well as to illustrate the defect areas such as separation in walls, cracks in plaster and the missing elements.

### **Stage Two: Dilapidation Survey and Building Investigation**

A dilapidation survey is usually called preliminary inspection of the building. This survey is carried out through visual inspection of the heritage building, eventually, with the help of simple optical devices such as binoculars, etc. In some cases the separation or cracks of the surface of elements of the heritage building, will be required (CIB Commission. 2010). According to

Norlizaiha, (2011), a dilapidation survey is the practice of identifying and <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>

recording building defects through the means of photography and digital documentation prior to any conservation work. The dilapidation survey is the process of exploring a heritage building to collect and record information based on observation of the surfaces and any exposed structure.

Dilapidation surveys are considered instrumental if they achieve the following aspects (A Ghafar, 2004; Norlizaiha, 2011): Understanding the state of building defects. Determining the causes of the building defects. Identifying suitable methods and techniques of buildings conservation. Providing reference materials to client, consultants and projects contractors. A Ghafar (2004) determined a multidisciplinary approach which makes the practice of dilapidation survey effective. He mentioned that the dilapidation survey should include a multidisciplinary approach which requires in-depth knowledge in conservation as well as other related fields so that correctly evaluate building defects, determine their causes, and proposes restoration methods. In addition, heritage buildings and their components should be investigated before taking any action. There are two stages of investigation, site testing and laboratory test (Norlizaiha, 2011). The site can be tested by assessing material condition. In this investigation stage, some instruments such as a thermometer to measure the temperature of the environment can be used. Additionally, laboratory test should be used when visual inspection is unable to analyse the building defect. For example, to test the original composition of a material like mortar and plaster, laboratory test should be used in this case.

### **Stage Three: Conservation Works**

After the diagnosis of the defect of heritage buildings, a proposal of statement on the methods and techniques of repair and conservation of heritage buildings should be prepared. For example, cleaning the building surface from dirt and fungus is the preliminary activity in which the conservation works should begin first. All undesirable vegetation should be cut and positioned away from the building to prevent future root damage. In addition, temporary structure should be used to consolidate the building (A Ghafar, 2004). The main conservation works will begin after preliminary works are completed. By doing this, the appearance of heritage building becomes clear and the conservation activities can be managed regularly such as removing rotten timber and deteriorated plaster. The activities should be followed by preservation, restoration, repair and reconstruction activities. The building conservation process begins with roof repair and continue with others part of building elements. The process is from the top to the down of the heritage buildings (Norlizaiha, 2011). In Malaysia, for all listed heritage buildings, conservation processes and activities are guided and controlled by the conservation guidelines and standards from the National Heritage Department, especially, in the selection of the materials and techniques. As such, traditional materials like lime plaster, brick and mortar should be respected. If the traditional material is deteriorated, the new material must compatible with expression, appearance, texture, scale, colour, materials and form of the original. The reconstruction of missing and damaged elements also should respect the original technique and the design must base on historical documentation and compatible with the historic character. The last step in building conservation is the preparation of the <https://assignbuster.com/preserving-of-the-embodied-energy-environmental-sciences-essay/>



final report. The final report contains all conservation processes. Therefore, it is deemed an important evidence for future reference on heritage conservation and maintenance (Norlizaiha, 2011).