

## **Adaptive Reuse of Industrial Buildings: Case Study of Tenten Factory in Famagusta**

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### **Abstract**

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The term of adaptive reuse is determined as the reuse of old buildings for new purposes. This action has social, environmental and economic benefits for cities and their inhabitants. There are many industrial buildings in Famagusta, Cyprus having high potential for reuse. Unfortunately, the industrial buildings in Famagusta, mostly from early 20<sup>th</sup> century, are vacant or don't have the appropriate functions. The main aim of this paper is to evaluate the potential of industrial buildings and develop an adaptive reuse model for Tenten factory, selected as a case study for this research. The methodology which is used for this study is qualitative research such as review of the literature about adaptive reuse, sketching and mapping of the building and assessment of the features of the building for proper adaptive reuse opportunities. Finally, this study aims to discuss sustainability in adaptive reuse of industrial building.

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**Keywords :** Heritage conservation Industrial building Adaptive reusesustainability

### **1. Introduction:**

In the subject of conservation, adaptive reuse of existing buildings is not a new term. In the past, the buildings having a firm structure, have been converted to have new functions without any problem. Through the renaissance period, some of the monuments' functions have been changed or during the French revolution the religious buildings were converted for the military usage or industrial purposes [1].

#### **1.1. Aim of the paper:**

The main aim of this paper is to enhance the term of adaptive reuse as a part of heritage conservation and also value of industrial buildings as a part of history of our society. For this aim, an industrial building has been selected as a case study and a model has been proposed for its' adaptive reuse action by keeping the authenticity of the building and its original feature.

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## **1.2. Problem statement:**

Famagusta is a city with the strong historical background and also rich in variety of modern period industrial buildings. The main problem of this study is that industrial buildings in Famagusta are abandoned due to lack of attention to these buildings and their values.

## **1.3. Research methodology:**

The methodology for this study is firstly the literature review on the subject of industrial buildings as a part of heritage conservation and also adaptive reuse of these kinds of buildings. Secondly, the case study evaluation approach is used as a methodology of this study. For better understanding of the case, documentation of the building (photographs, approximate sketch drawings, plans, sections and elevations) of the building have been done and also a proposal for management and interpretation of the building have been developed.

## **2. Review of the literature**

### **2.1. Industrial heritage conservation**

The first discussions about conservation of industrial heritage have started from 1950 by Michael Rix, whereas in 1973 the first congress about conservation of industrial heritage was held with the subject of 'evaluation and development of industrial buildings and their value' [2]. After the congress, international organizations such as ICOMOS and UNESCO have put forward their aim of conservation of industrial heritages. The main aim of ICOMOS charter on industrial heritage was the value of these kinds of buildings such as social cultural and also technological value [3-5]. After that there are some other different charters such as Nizhny Tagil charter for industrial heritages of 2003. The Nizhny Tagil charter is on the conservation of industrial heritage buildings, emphasizes the sense of identity of the building "Article II. The industrial heritage is of social value as part of the record of the lives of ordinary men and women, and as such it provides an important sense of identity." [6].

When the term of sustainable development appeared in the field of conservation of industrial buildings, it helped to develop the field, with the goal of social, economic and cultural benefit. Above argument it seems that the goals of conservation of industrial heritage are parallel with the goals of sustainable development. In this respect, the conservation of industrial heritage and adaptive reuse of industrial buildings are in similar and parallel, so in the following text, we will have the definition of adaptive reuse as a sustainable way of conservation of industrial heritages.

### **2.2. Definition of adaptive reuse as a term for conservation of historic building:**

Burchell & Listokin in 1981 described that the term of adaptive reuse is a revitalization approach, which has the plan for reuse and management of abandoned or leftover buildings. The most important feature of adaptive reuse is that it deals with the buildings or the lands, which was suitable for its previous use and it is no longer appropriate in that specific building type or location, and as a result, the value of the building will increase by adaptation of the building, which has the aesthetic, economic social and cultural value, for a new use [7].

### 2.2.1. Adaptive reuse principal

Loures & Panagopolos (2007) state that, Adaptive reuse is a challenge, which seeks for a balance between: restoration, adaptation and change of the building through appropriate project of adaptive reuse. It should have 5 design principal:

- “Perform the functions well for which they are redesigned
- Be long lasting and adaptable to new uses
- Respond well to their surroundings and enhance their context
- Have a visual coherence and create ‘delight’ for users and passers-by
- Be sustainable – non-polluting, energy efficient, easily accessible and have a minimal environmental impact” [8].

Adaptive reuse process has need of professional developer with the creative solution and unique project. Importance of using the old building in the city and the possibilities that the building can create identified by Jane Jacobs in (1961) “Old ideas can sometimes use new buildings. New ideas must use old buildings.” So the adaptive reuse project can apply in any kinds of building such as industrial building, churches and any other kinds of building [9].

### 2.2.2. Benefits of adaptive reuse:

Adaptive reuse itself has various advantages such as social economic and environmental benefits. Environmental benefits of adaptive reuse consist of recycling the existing structure and materials. Reusing these buildings mainly based on the fact that these have the high quality and potential for reuse, they have the higher lifetime, reusing of the existing buildings can reduce the urban sprawl, and conserve the natural environment. On the other hand, attention to the energy efficiency of the buildings by improving heat transfer coefficients of the wall and roof sections for a better cooling and heating, should be given [10].

Social advantages adaptive reuse of industrial heritage buildings are revitalizing the building and its environment and improving cultural values. In the neighbourhood, the buildings which are dated to older periods have the capability of acting as a connection to the past and also capacity for creating the ‘sense of place’. So, improving and reusing of the industrial buildings are more valuable than demolishing it and it helps the society to have the variety of building types of different ages and cultures. Reducing the amount of ruined or unused building by reusing those helps society to have less crime and unsafe actions in the zone and also it can create a better social life for the neighborhood [10].

The economic advantages of adaptive reuse would be both for developer and for municipality, because, developer benefit from low tax action and the municipality benefit from the creation of a newly developed building in the vacant site, where there is no need to provide the facilities for infrastructure into the site [10].

Although, adaptive reuse has various benefits for the municipality and community, this action totally depends on the developers. It may be attractive for them under a number of condition: First of all, if the building become out of work for its existing function for several reasons, the person who owns/ runs the building may change its function and in this situation, reuse of the building can have the highest financial improvement [11].



Secondly, the reuse projects cost lower in comparison with new building construction. So developers can benefit from reducing the costs and use of materials by utilizing existing buildings. Adaptive reuse can also incorporate environmental and historical value [12].

### 3. Case study:

Tenten factory in Famagusta have been used as a case study of this paper.

#### 3.1. Location of the building:

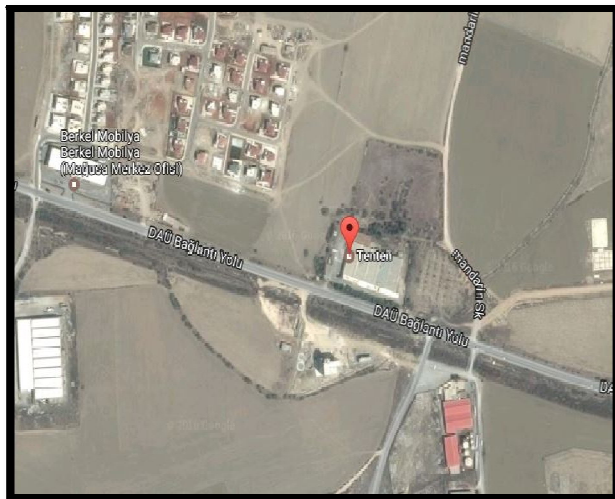
**Figure 1: Cyprus, Famagusta map. (Source: Google map)**

Tenten food product factory which is located in Cyprus, Famagusta (Fig.1) is an industrial building.

The building is located (Fig.2) on the EMU Connection Road Bağlantı Yolu, Tuzla and it has direct access to the Main Road. So, it has a good accessibility to the main road and its easy access is one of the advantages of building's location. The neighbourhood buildings are a few old factory buildings and some new ones such as residential buildings furniture wholesale building, and a gas station. These lately developed new constructions prove that the area is going to have a population growth.

#### 3.2. History of the building:

According to the observations and interviews with the employees of the factory was used as a juice factory during the first phase after its construction between 60s and early 70s. After the owner of the building has changed, the new owner started producing potato crisps as well as corn since 1975. The company also imports all kind of nuts, roast and pack them for marketing in -North Cyprus.



#### 3.3. Value of the building

Industrial buildings, especially the large complexes had an important reuse value, because, they have the ability to serve for different functions. They also have a social value, as these buildings are like a part of recorded life of the old users, so they have the sense of identity within it. Also, they have the scientific and technological value in history of construction, manufacturing and engineering, and the aesthetic

value for its architectural design [6].

The architectural style (Fig.3) of the Tenten Factory Building is reminding the modern period and architectural understanding of Le Corbusier, because of its horizontal windows through the main façade of

**Figure 2: Location of the building (source: Google map)**



the building along its entire length and provide the natural light for the building, the free design of the ground plan, elevated building on pilots in south part of the building, which all contribute to the aesthetic value to the building. Besides, the large openings on three sides of the building and trusses of the roof system are authentic elements, which should be considered.

**3.4.Proposal for reuse of the building:**

**Figure 3: architectural style of the building (photo by authors)**

The proposal that has been developed for the adaptive reuse of Tenten factory is an answer to the question of ‘transforming a modern period industrial building to a sustainable and innovative school of art and architecture’, the main decisions for the renovation of structure has been defined as; preserving the early industrial features of the original factory, original openings of the building and the truss roof system, for the beneficial use of daylight, replacing the aluminium panels with glass at certain parts of the roof. An interior courtyard has been proposed to serve as a public gathering area for the building. The courtyard is planned to have direct access from the entrance of the building and to accommodate a sculpture with the view from outside, providing the sign of school of art to the users/ visitors of the school building (5).

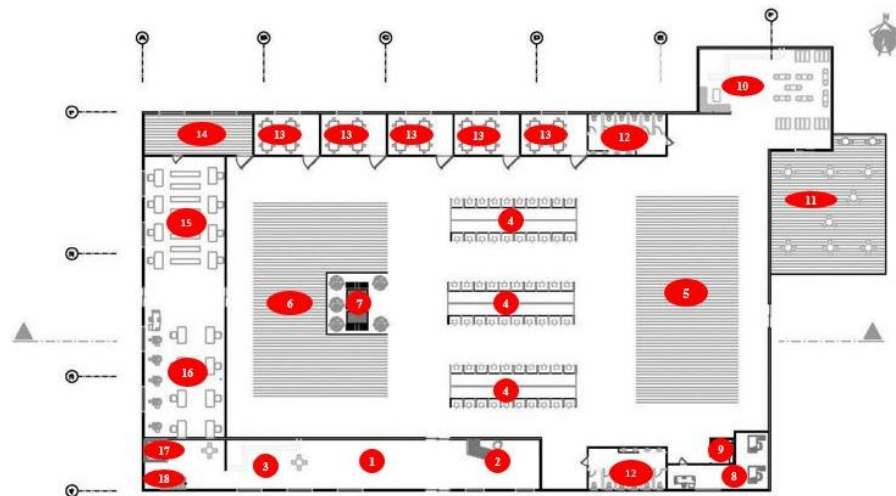
**3.4.1. Proposal for interpretation of the building:**

**3.4.1.1. Innovation of design:**

The school of art and architecture had the goal of revitalizing the building and its neighbourhood by providing an active school increasing the activity and movement in the area. By implementing this project, population around the building will be increased and will have positive social and economic effects in the neighbourhood. Also, it has an innovation in design by transforming the factory building to a school of art and architecture to minimize the negative impacts of pollution of factory for neighbourhood, where residential buildings are mostly located now. The other decisions on project proposal are; utilizing open and flexible plan to minimize the negative influences of adaptive reuse; creating flexible spaces; using the pre-fabricated materials to avoid interventions to the infrastructure of the building; respecting the authenticity of the building; creating a balance between preserving the history of the building; and paying attention to the energy efficiency of the building by providing open-plan and natural light from outside.

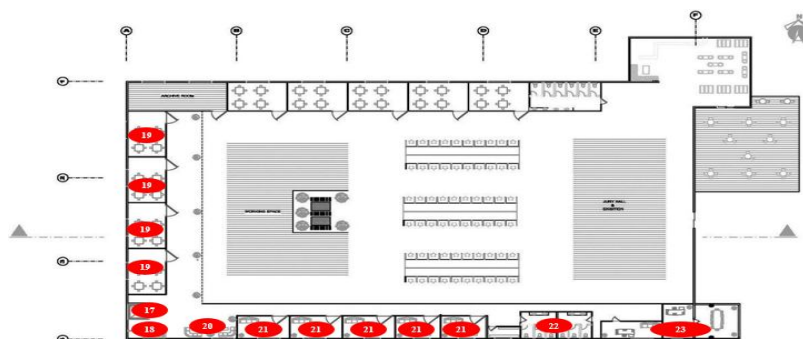
### 3.4.1.2. Interior space organization of the school of art and architecture:

#### Ground floor plan organization:



The proposal for school of art and architecture consists of the ground floor (Fig.4) for classrooms and social activities for the students and first floor for classrooms and administration. In interior space organization, the main entrance location was not changed in order to respect the authenticity of previous building function which was allocated in south side of building. After entrance, the (1) lobby space consist of a (2) desk for the security in the right side and a (3) sitting space in the left side for waiting people, which is specified for those who waits for students/ staff members of school or those students or staff members who are waiting for the bus, taxi or etc.

After passing the lobby, the huge open space is divided for different functions including (4) tree lines desks with chair providing space for students to work together in their specific place when they need to draw something or when they need to do their research, they will have the opportunity to use their specific space, which is separated By glasses.



**Figure 4: Ground floor plan organization (Drown by authors)**

In the right side of these desks, there is the interior courtyard space (5) proposed as the main gathering area, which will be used for different event organizations, exhibitions and jury sessions that need the huge space. On the left side of main entrance, providing a different working space (6) has been provided as a workshop for pottery, model and sculpture making. Next to this space, there is a sitting area (7) with small sitting spaces near the pools, proposed for providing a refreshing space for students.

The south-east corner of the building is planned to provide the small office (8) for faculty staff members and also indoor (9) printing room. The north-east corner there is an (10) and outdoor café (11) and restaurant. In north and south of the buildings, there are toilets (12). Five classrooms (13) for different purposes are located in north part of the building, and there is an archive room (14) in the left corner. In east side of the building, there is a library (15), a computer lab space (16) and at the corner there are



elevator (17) and stairs (18) for access to the upper floor. It is important to mention that all spaces of the building such as classrooms, library, toilets, exhibitions and offices have the natural lighting from windows and also roof.

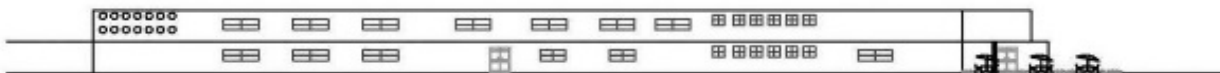
### First floor plan organization:

The access from ground floor to the first floor (Fig.5) is from west-south corner of the building and it is by

#### Figure 5: First floor plan organization (Drawn by authors)

Both stairs (18) and the elevator (17) (the elevator is considered to be used by disabled students). By entering to the first floor, there have been provided 4 more classrooms (19) on the left side and a sitting and working area (20), administration units like office spaces (21), toilets (22), and management offices (23) with the meeting room space on the right side. The section and elevation of the building is drawn as below (Fig.6) (fig.7).

#### Figure 6: North section of the building (drawn by authors)



#### Figure 7: elevation of the building (drawn by authors)

### 3.4.2. Proposals for Management of new function and its sustainability



#### 3.4.2.1. Land use and site ecology:

#### Figure 8: landscape of the building and ecology (Design by authors)

In the adaptive reuse process, attention to the green outdoor spaces (Fig.8) has been given to increase the sustainability of the building and site. Due to the aim the project, the green spaces and site ecology of the building has an utmost importance, whereas the original land use layout of the site did not provide any green spaces.

In the reuse project, the green spaces, both in inside and outside the building has been aimed to be enhanced for providing the offset carbon emission all around the building.

**Figure 9: The clearstory windows in all around the building (Design by author)**



**3.4.2.2. Lighting:**

The clearstory windows (Fig.9) all around the building provide daylight for interior. Similarly, the punched windows on the south-west and west facades and sky light on the roof are the other sources of natural light for building. In the proposed design project, each space, such as open, closed and semi open space of the building have openings to take the natural daylight in.

**3.4.2.3. Water cycle:**

According to the LEED (2009) guidelines, maintenance of landscapes allocates 30% of water consumption. Therefore, a self-sustaining landscape without any need for irrigation has been planned for this project. The use of native plants in the land in the interior of the building site to avoid use of pesticides or the chemical fertilizers, and storing the excessive rain water in winter, would help facilitating sustainability.

**Figure 10: The proposed material for the new use of building interior (by authors)**

proposal for Environmentally Friendly material	Description
Maximize the efficient use of space	Efficiently used interior spaces can keep the size of a building and, therefore, the use of construction materials and other resources to a minimum.
Use energy-wise construction and design materials	For the Interior space possible to work with windows and doors that maximize energy efficiency, wood flooring that comes from rapidly renewable sources like bamboo, water-saving toilets and other environmentally responsible materials.
Use materials produced in a socially responsible manner	Use furniture and products from sources that promote safe manufacturing processes and socially just business practices. When possible, use local sources.
Reduce waste by using reclaimed or recycled materials	Fortunately, antique and vintage décor is an option for interior designers. Furniture and decorative items can be repurposed, refinished or otherwise refurbished to give them new life. For the truly environmentally conscious, tiles, carpets, fabrics, even sinks and counters can be made from recycled materials.
Plan for energy-efficient lighting	incorporate windows and skylights to maximize the use of daylight and minimize artificial light. When artificial lighting is needed, LEDs, halogens and compact fluorescent light bulbs save energy and last longer.
Use non-toxic and non-polluting products	An increasing variety of safe and chemical-free products is available, from organic, hypoallergenic paint to fibers and woods that haven't been treated with pesticides.



#### **3.4.2.4. Energy feature of the building**

For the energy efficiency of the building, high efficiency fixtures will be preferred and the sun light will be used more efficiently by utilizing lighting sensors that make adjustments based on conditions such as occupancy or daylight availability for reducing the energy consumption of the building, solar panels will be placed on the roof of the building.

#### **3.4.2.5. Material and construction:**

It is obvious that the utmost sustainable building is the building that has been already built. Reusing the existing materials after necessary repairs and keeping the intact part of the structure during the renovation will reduce the use of new materials (Fig.10) and will provide economic benefits. The criterion for new materials to be used in the interiors of the building is listed in the 2<sup>nd</sup>, 3<sup>rd</sup> and 6<sup>th</sup> rows of the table below: By providing the open plan space, the financial resources that may be needed in case of any future changes in the function have been decreased. Open plan decision also helped to reduce the costs of the installation by providing the opportunity to use movable and easily uninstal able materials.

#### **3.4.3. Intervention proposals for the materials and structural system:**

The main aim of the proposed interventions to the building is to preserve the authenticity and integrity of the building. Considering this aim and the potential of the building for being reused, different interventions have been proposed to be applied to the building for its new use, such as:

##### **3.4.3.1. Cleaning**

Cleaning consists of structural cleaning, interior cleaning, and roof cleaning, mechanical cleaning, and also plant cleaning in the site of the building (Fig.11). Unhealthy, non-functioning, low energy efficient materials like aluminium panels will be removed from the building during this cleaning process and will be replaced with appropriate ones, which will be in harmony with the original building materials.

##### **3.4.3.2. Structural system consolidation**

The load bearing elements of the building, which are reinforced concrete columns have distress and fractures in some parts that need consolidation. The type of distress should bedetected to find out if it is structural or non-structural. If the distress and fractures are structural, the reinforcement should be controlled. After examining type of stresses, carbonation and spanning problems, suitable treatment should be implemented. Consolidation of the structure by injection of the appropriate materials into voids, and by providing additional supports, where necessary for strengthening the structure, may be done. If the problem is non-structural, the surface will be repaired by sealing, plastering and colouring.

##### **3.4.3.3. Use of new material**

During the renovation of the building, there will be a need to use new materials both for replacing the non-functioning deteriorated materials and low quality, lately added materials or addition of new materials to fulfil the needs of the new function. Besides the criterion for new materials, listed in the 2<sup>nd</sup>, 3<sup>rd</sup> and 6<sup>th</sup> rows of the table below, there are some principles that have been developed for the selection of new materials:

New materials should not be dominating and hindering the authentic structure and materials. The additional parts like division walls, should be light, plain and contemporary, so that they can be differentiated from the existing parts of the building. The additions should not be causing any loss in the values of building, like its architectural style, spatial qualities and original architectural elements. The materials that will be used for the consolidation of the structure, improvement of energy efficiency and fire safety, should be preferred to be lighter and smaller in cross section, rather than being bulky and heavy.

#### **3.4.3.4. Fire safety**

It is the fact that when this building was designed fire protection of steel structure was not taken into consideration. For the improvement of the fire safety, fire proofing of the structural materials, especially the steel elements of the roof, have been proposed. A new fire safety proposal, including the design of fire exits and fire detection and extinguishing system for the new function of the building is needed.

#### **4. Conclusion**

As observed in many good practices of adaptive reuse of industrial heritage buildings in last decades, they have the potential to transfer the culture of the society from past to present. On the other hand, if the special consideration and attention that they need is not provided, they can easily get abandoned and demolish as a result of the neglect of the society. In this study, Tenten factory, a good example of the industrial heritage in Famagusta, was examined and a proposal for a new use as a school of art and architecture has been developed. Authors have attempted to provide a contemporary adaptive reuse approach for the building, which will help to solve the problem of lack of attention and make the building more beneficial for the society and the neighbourhood. Additionally, the notions of 'sustainable development' which has social, economic, and cultural advantages have been applied to the proposal for adaptive reuse of the building. Authors have attempted to enhance to the subject of 'sustainable adaptive reuse of industrial heritage buildings by discussing related issues like minimum intervention, authenticity, energy efficiency, adaptive reuse of heritage buildings as important goals of heritage conservation and sustainability.

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