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Integrating Heritage Conservation and Sustainability for Adaptive Reuse: A Case Study of Tarabish Factory in Fowah City, Egypt

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ABSTRACT: This study investigates the integration of heritage conservation and sustainability principles especially in the adaptive reuse of historic buildings, focusing on the Tarabish Factory in Fowah, Egypt. It explores how heritage preservation and sustainable development can be effectively combined to revitalize this historically significant building. The findings reveal substantial gaps in the application of sustainable conservation principles at the Tarabish Factory. Despite the building's retained cultural, historical, and architectural values, there is an urgent need for a comprehensive strategy to address these deficiencies. The research includes exploring sustainable heritage conservation principles and then applying them to the Tarabish factory building to discover how this building meets the heritage conservation principles which reached 31.25%, thus providing a proposal for the adaptive reuse of the building, and evaluating the proposal according to the established principles which reached 81.25% It concludes with practical recommendations for applying adaptive reuse strategies to other heritage sites, contributing to the broader dialogue on sustainable heritage management in Egypt and the wider Middle East.

Keywords*: heritage, conservation, sustainability, adaptive reuse, Fowah city, Tarabish Factory.*

1. INTRODUCTION

Integrating heritage preservation with principles of sustainability is essential for preserving cultural values and fostering environmental responsibility.(Tang et al., 2024) Integrating heritage conservation with sustainability through adaptive reuse is increasingly recognized as a vital strategy for preserving cultural identity while promoting ecological and economic benefits. This approach not only revitalizes historical structures but also enhances community engagement and property values. As an economic benefit, adaptive reuse of heritage buildings has been shown to positively influence adjacent property prices, as evidenced in Hong Kong, where revitalization efforts led to increased economic activity and cultural appreciation.(Kee, 2019) The success of adaptive reuse strategies is significantly influenced by societal perceptions of cultural heritage. In Kaunas, Lithuania, a model was developed to assess these perceptions, highlighting the need for community involvement in decision-making processes.(Dogan, 2019) Adaptive reuse contributes to ecological sustainability by utilizing existing structures, thus conserving resources and reducing waste. Research indicates that integrating environmental rating systems with adaptive reuse models can enhance the sustainability of heritage buildings. (Farjami & Türker, 2021) Tarabesh Factory in Fowah City can employ several environmental architectural practices that align with contemporary sustainable design principles. The factory may benefit from practices that will be highlighted in sustainable conservation and adaptive reuse, maintained. (Bechthold, King, Kane, Niemasz, & Reinhart, 2011) While the integration of heritage conservation and sustainability through adaptive reuse presents numerous benefits, challenges remain, particularly in balancing modern needs, historical integrity, and sustainability. The paper will answer the question of How to integrate the principles of heritage conservation and sustainability into the adaptive reuse of historic buildings, with a particular focus on the Tarbush factory in the heritage city of Fowah in Egypt.

1.1 RESEARCH GAP

There is a notable gap in the current body of research on adaptive reuse concerning the amalgamation of sustainable methods and heritage conservation. Although many studies examine each component separately, very few thoroughly examine how they are related, especially in settings such as Fowah City, Egypt. This impedes practical implementations in urban development projects and restricts intellectual discourse. Closing this disparity can result in better-informed policies that support sustainable practices and cultural heritage. Therefore, the main goal of this study is to assess critically how heritage conservation and sustainable design principles may coexist peacefully with the adaptive reuse of the Tarabish Factory. This research aims to create a framework that highlights the advantages of merging these two dimensions through a thorough case study, ultimately offering useful.

2. THEORETICAL FRAMEWORK

In order to protect historical, architectural, and culturally significant buildings for future generations, heritage conservation is a crucial technique. The act of preserving these structures requires not only their physical preservation but also safeguarding the tales and values that are ingrained in them. Adaptive reuse, which involves giving older buildings new uses while maintaining their historical significance, is one of the tactics that is becoming more and more common in this subject. Maintaining the physical and cultural integrity of these places enables sustainable community development, as demonstrated by the adaptive reuse of industrial structures, as demonstrated by the case studies in Turkey. Additionally, as demonstrated by projects in Asian nations, the incorporation of sustainability concepts into historical conservation highlights the necessity for creative solutions that respect historical significance while enhancing modern utility.(Babutsalı Alpler, Şahin, & Dağlı, 2020)

Heritage conservation is the process of preserving an object or site's important features so that future generations can enjoy its authenticity, longevity, and integrity. Heritage assets, which include structures, monuments, landscapes, and artifacts, have cultural, historical, artistic, and scientific worth that must be preserved, maintained, and managed. In addition to keeping these treasures safe from deterioration, abuse, or devastation, heritage conservation aims to preserve their cultural relevance while enabling continuous use and enjoyment.(Feilden, 2007)

Adaptive reuse is repurposing existing buildings or sites for a purpose different from the one for which they were intended or designed. In order to give historic buildings a new lease on life while maintaining their cultural and architectural value, this strategy is frequently used. Reusing existing structures while preserving them is viewed as a sustainable approach that lessens the environmental impact of new construction while balancing the need for development with the preservation of historic buildings.(Cantell, 2005)

A strategy known as Sustainable heritage conservation incorporates sustainability ideas into the process of preserving cultural assets. It aims to strike a balance between the demands of the current and future generations and the preservation of cultural assets, making sure that conservation efforts do not jeopardize the sustainability of the environment, society, or economy. By placing a strong emphasis on resource management, reducing environmental effects, encouraging community involvement, and promoting economic viability, this strategy makes sure that heritage conservation has a positive impact on both environmental and community sustainability.(Mason & Avrami, 2002)

Sustainable adaptive reuse The process of repurposing existing structures or locations in a way that supports the objectives of sustainable development. This strategy strives to lessen the environmental damage associated with demolition and new buildings in addition to extending the life of cultural sites by finding new, appropriate uses. Energy efficiency, resource conservation, and reducing carbon emissions are the main goals of sustainable adaptive reuse, and it also makes sure that the new use honors the building's historical and cultural relevance. In order to make sure that the reuse supports the community's long-term existence, it also takes social and economic sustainability into account.(P. Bullen & P. Love, 2011) The following table shows the number of studies carried out in each area in the last five years from 2019 to 2024 (Miran & Husein, 2023):

Table 1: Number of studies on each building type. Source: Authors.

	Building Type	Number of studies (2019-2024)
1	Industrial Buildings	100
2	Commercial Buildings	80
3	Residential Buildings	50
4	Public Buildings	40
5	Religious Buildings	25
6	Educational Buildings	20

The following figure illustrates the number of studies conducted in each area.
The figure highlights a clear trend in adaptive reuse research from 2019 to 2024, with industrial buildings receiving

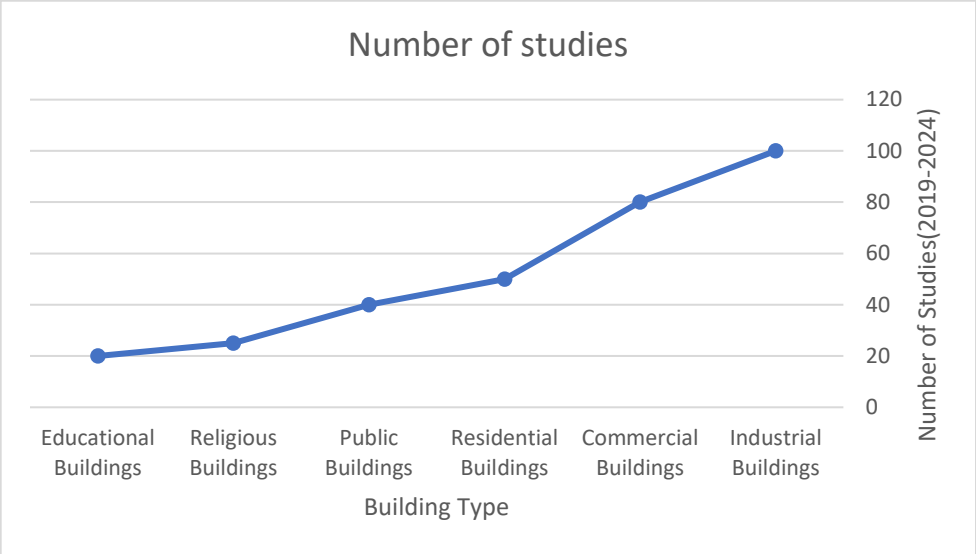


Figure 1: Number of Studies from 2019 to 2024. Source: researchers

the most attention, reflected by approximately 110 studies. This focus underscores the significance of industrial buildings, which are ideal for adaptive reuse due to their size, location, and architectural features, making them crucial for sustainable urban development and heritage conservation. Commercial and residential buildings also see notable research interest, while educational, religious, and public buildings are less studied, they still offer potential for adaptive reuse.

3. PREVIOUS STUDIES

The theoretical background for heritage conservation and sustainability in adaptive reuse emphasizes community involvement and the integration of various perspectives. Participatory heritage approaches advocate for balancing economic revitalization with social sustainability, as seen in urban regeneration efforts like those in Fowah City, which must reconcile modern demands with heritage preservation [2]. The emotional connection between past and present is crucial, as demonstrated by the conversion of industrial heritage sites into cultural spaces, fostering community engagement and sympathy for conservation efforts. Additionally, urban resilience theory highlights the importance of revitalizing not just physical structures but also the social and economic fabric of historical districts, promoting adaptability and sustainability (Насирдинова, Иманкулов, & Алшоразов, 2024). Thus, integrating these theoretical perspectives can inform effective urban regeneration strategies, exemplified by the Tarabish Factory case study, which aims to achieve equitable communities while preserving cultural heritage (55). In addition to conserving a building's architectural integrity, effective conservation helps communities thrive socially and economically. In cities like Fowah, the challenge is to balance the economic benefits of tourism and the

preservation of local cultures and communities' means of subsistence. (Elbelkasy, 2024) The adaptive reuse of the Tarabish Factory in Fowah City, Egypt, presents a significant opportunity for urban revitalization and heritage preservation. This approach not only addresses land scarcity but also enhances community livability and identity. The Tarabish Factory, as a historical industrial site, embodies local heritage, making its preservation vital for community identity. (- & -, 2023) Adaptive reuse can revitalize the factory, transforming it into a multifunctional space that reflects the community's historical narrative while serving contemporary needs. (Bassal & Khalifa, 2022) While adaptive reuse offers numerous benefits, challenges such as funding, regulatory hurdles, and community resistance may arise, necessitating careful planning and stakeholder engagement to ensure successful implementation.

4. PRINCIPLES OF SUSTAINABLE HERITAGE CONSERVATION AND THEIR RELEVANCE TO ADAPTIVE REUSE

Principles of sustainable heritage conservation emphasize preserving the cultural, historical, and architectural significance of heritage sites while ensuring their adaptability to contemporary needs. These principles advocate for minimal intervention, the use of environmentally friendly materials, and the integration of modern technologies that do not compromise the site's historical value. In the context of adaptive reuse, these principles are crucial as they guide the transformation of historical structures into functional spaces that meet current requirements without erasing their original character. This approach not only extends the life cycle of valuable heritage assets but also contributes to sustainable development by reducing the need for new construction and preserving the cultural fabric of communities (P. A. Bullen & P. E. Love, 2011). Key principles include (Mughal, 2011):

Table 2: The principles of sustainable heritage conservation.

	The principles of sustainable heritage conservation	Explanation	Application	Example	Source
1	**Preservation of Cultural Significance**	Maintain the historical values of heritage buildings Maintain architectural values of heritage buildings. Maintain the cultural values of heritage buildings.	Avoid unnecessary alterations and ensure that any modifications respect the building's historical integrity.	In order to preserve the Alhambra's acknowledged historic importance, restoration efforts in Spain are conducted with due respect for the original Islamic architecture and ornamental arts.	(Amar, 2017; Crespo-López López, Arizzi, Pardo, & Antonio, 2020; Leifeste & Stiefel, 2018)
2	**Minimal Intervention**	Intervene as little as possible to preserve the original fabric of the building.	Use minimum interventions where possible, and prioritize repairs over replacements to retain the original materials and structure.	The Westminster Abbey's facade is being cleaned with laser procedures in order to protect the original stone without causing chemical damage.	(Dionísio, Martinho, Grangeia, & Almeida, 2013; Leifeste & Stiefel, 2018)

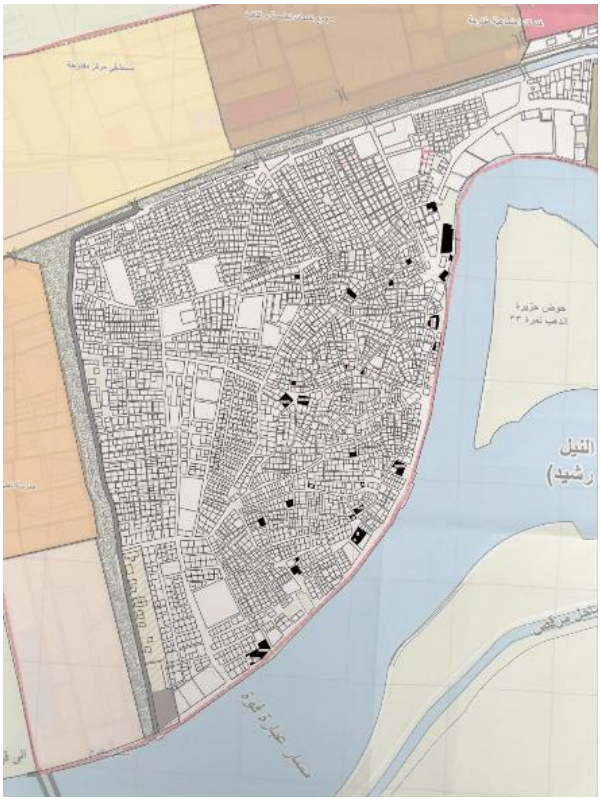
3	**Use of Sustainable Materials and Techniques**	Employ environmentally friendly materials and conservation techniques that minimize the ecological footprint. This includes using locally sourced materials, reducing waste, and opting for energy-efficient solutions.	Implement energy-efficient retrofitting, such as improved insulation, without compromising the building's historical character.	The use of recycled stone and lime-based mortar in the restoration of the Colosseum in Rome, which both preserves the original look and supports sustainability.	(Fierascu, Doni, & Fierascu, 2020; Leifeste & Stiefel, 2018)
4	**Energy Efficiency**	Enhance the energy efficiency of heritage buildings to reduce their environmental impact while preserving their historical significance.	Incorporate energy-efficient heating, cooling, and lighting systems that are sympathetic to the building's original design and do not detract from its appearance.	Installation of thermally efficient, double-glazed window units designed to mimic the historic single-pane windows in the Victorian-era Liston Hall in the UK, improving energy efficiency without compromising historical authenticity.	(Amar, 2017; Leifeste & Stiefel, 2018; Webb, 2017)
5	**Adaptive Reuse**	Repurpose heritage buildings for new uses that ensure their continued relevance and preservation. Adaptive reuse allows buildings to meet contemporary needs while maintaining their historical and cultural integrity.	Convert unused or underused heritage buildings into functional spaces such as offices, residences, or cultural centers, ensuring that new uses are compatible with the building's character.	The transformation of the High Line in New York City from a disused rail line into a popular urban park and walkway, revitalized the structure and the surrounding area while retaining its historical significance.	(Coscia, Lazzari, & Rubino, 2024; Leifeste & Stiefel, 2018)
6	**Long-Term Maintenance and Management**	Establish practices for the ongoing care and management of heritage properties to ensure their preservation over time.	Develop and implement a maintenance plan that schedules regular inspections and timely repairs to avoid larger issues down the line.	The ongoing maintenance program at the Tower of London, includes regular checks and repairs to ensure the preservation of the site's physical and historical integrity.	(Anfinson, 2018; Leifeste & Stiefel, 2018)
7	**Community Involvement and Social Sustainability**	Encourage community engagement and support in conservation efforts to ensure that heritage conservation benefits local communities and respects their values and history.	Facilitate workshops and open days at heritage sites to involve the community in the conservation process and educate them on the importance of preserving cultural heritage.	Community-led tours and educational programs at the Chichen Itza in Mexico, which involve local guides and focus on the Mayan cultural heritage, supporting both preservation and local economic sustainability.	(Leifeste & Stiefel, 2018; Li, Krishnamurthy, Roders, & Van Wesemael, 2020)

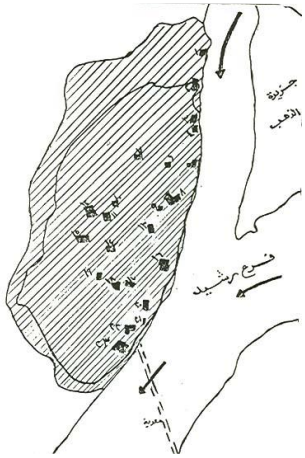
8	**Economic Viability**	Ensure that heritage conservation projects are financially sustainable and contribute to the economic well-being of the area.	Seek funding and grants for conservation projects and develop revenue-generating activities that do not compromise the integrity of the heritage site.	The development of a boutique hotel within the precincts of the UNESCO World Heritage site of Petra, Jordan, which generates revenue for ongoing conservation efforts while boosting local tourism.	(Burnham, 2022; Leifeste & Stiefel, 2018)

5. CASE STUDY ANALYSIS: TARABISH FACTORY

5.1 FOWAH CITY

Fowah city is located in the north of the Nile Delta, Egypt, west of Rashid branch, 35 km from Kafr el-Sheikh governorate, which extends on the Nile coast about 2 km, and its residential area is approximately 270 acres. Fowah is a religious city and Egypt's third-largest city in terms of Islamic and historical buildings. The city has 356 mosques, corners, factories, etc (عزب & خالد, ٢٠٢١). As shown in the following figure.





1-Dome of Abu al-Najah
2-Musasaied Mosque
3- Al-Nimiri Mosque
4- Al-Iraqi Mosque
5-Sheikh Sha'ban Mosque
6-Sheikh Naim Mosque
7-Abu Sha'rah Mosque
8-Al Qunayi Mosque
9. Dome of the Gazar
10- Mosque, Da 'ah al-Dar
11-Tekiah
12- Al-Omari Mosque
13- Qamiah House
14- Al-Baki Mosque
15 - Korani Mosque
16-Hassan Nasrallah School
17- Mosque, Dubai
18- House of Al-Dobi
19-Al-Ramili Hall
20-Abu al-Makarim Mosque
21-Cotton Yarn Factory (Malta Gate)
22 - Sadat Mosque
23 - Tarabesh Factory

Figure 2: Some of the historical buildings in Fowah City. Source: . Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.

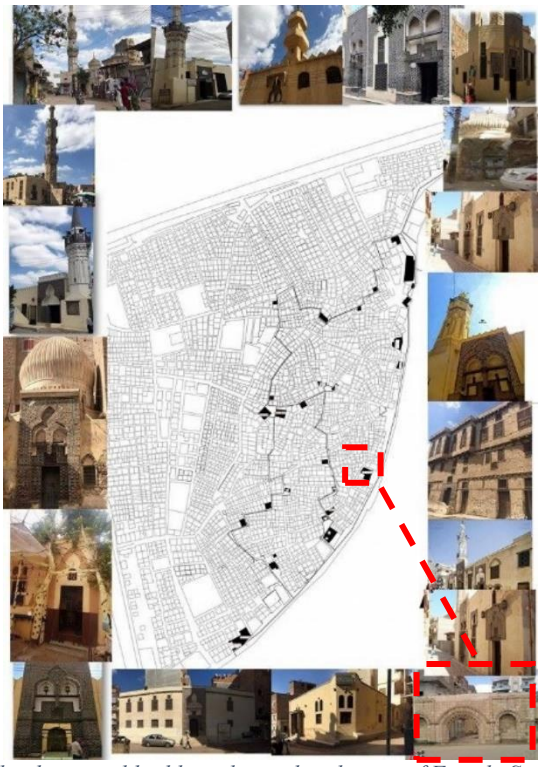


Figure 3: Trabish factory within historical buildings located in the city of Fowah. Source. Bachelor's degree 2018 , Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.

5.2 TARABISH FACTORY AS A CASE STUDY

The Tarabish Factory in Fowah City, Egypt, serves as a prime example of the region's rich industrial heritage, particularly in textile manufacturing, which plays a vital role in understanding the socio-economic history of Kafr El-Sheikh Governorate. Recent research emphasizes the importance of preserving industrial heritage sites like the Tarabish Factory, as they embody the architectural and cultural features of their era, contributing to the local identity and historical narrative. Conserving such sites is crucial, especially as they face threats from urban development and insufficient preservation policies(Damir, Oevermann, Meyer, Mahdavinejad, & Elmouelhi, 2024). Additionally, assessing the value of industrial heritage, considering historical, cultural, and economic aspects, is essential for promoting sustainable urban development and improving the local quality of life(Xu et al., 2024). By acknowledging and protecting the Tarabish Factory, stakeholders can promote cultural enrichment and tourism, ensuring that this important industrial heritage is preserved for future generations (Al-Zrigat, 2024).

5.2.1 Historical Features of The Tarabish Factory

The Tarabish Factory stands as a testament to the industrial history of Fowah City, reflecting not only the economic ambitions of its time but also the cultural values embedded in its architectural design. Established in the early 20th century, the factory showcased cutting-edge techniques and materials, exemplifying the transition from traditional craftsmanship to mechanized production. Architecturally, its large, airy spaces facilitated workflow efficiency, while stylistic elements such as arched windows and decorative facades highlighted the aesthetic priorities of the era. The interplay of functionality and beauty in its design reinforces the factory's significance in the local narrative of industrialization. Additionally, its preservation offers insights into the socio-economic conditions that shaped Fowah City during a pivotal period in Egyptian history, presenting an opportunity to engage with local heritage while promoting sustainable adaptive reuse strategies in the contemporary context of urban development.(Al-Zrigat, 2024; Damir et al., 2024)

5.2.2 Current Conditions

The design of the Tarabish Factory likely features large, open spaces that support production processes, reflecting the importance of spatial organization for both technical and social functions, as highlighted in studies on factory layouts(Peponis, 1985). High ceilings and expansive windows are crucial for natural ventilation and lighting, essential for ensuring worker comfort and efficiency. Research suggests that well-designed openings in factory walls and roofs significantly improve comfort through natural ventilation, indicating that such architectural elements would be advantageous in a factory environment(M. M. Hossain, Lau, Wilson, & Ford, 2017). Additionally, appropriate lighting conditions are critical, as inadequate lighting can negatively impact worker performance and comfort (M. Hossain & Ahmed, 2012). The structural design may also include repetitive elements like arches and columns, which provide stability while optimizing functionality, in line with recommendations for energy-efficient designs that consider building height and volume(Chowdhury & Alam, 2011). Altogether, these design features contribute to creating a supportive and efficient working environment. The factory still has some of its remains on the Nile Beach in Fowah, namely:

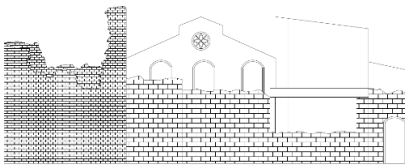
- The main entrance, built of stone and sweetened with wide, folded cranes, ends at the bottom with two toothy decades and is shrouded in two complex qualities. (Two determined contracts) Attached to the door is a single cranny that surrounds everyone and displays this section 14 AD (عزب & خالد, ٢٠٢١).
- By crossing the main entrance, another 6 m wide door is built with two round stones, each of which is topped with a toothpick that is surrounded by dry, then topped with nets and surrounded by two decorative frieze knots. The interior of this door is built with the common tangled bricks in those areas and then we find a vast space afterwards. On the right of the main entrance, we see a rectangular building roofed with a Gaalonian wood ceiling with two rows of rectangular and overhead windows knotted(عزب & خالد, ٢٠٢١) .

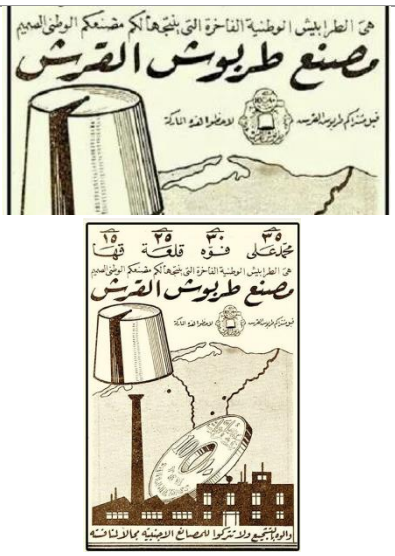
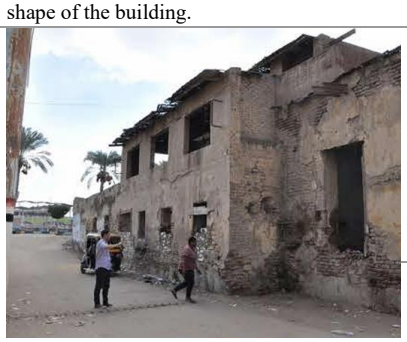
Figure 4: Tarabish Factory Photograph taken by Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.

5.2.3 *Applying Principles of Sustainable Heritage Conservation to Tarabish Factory*

Incorporating sustainable heritage conservation principles into the adaptive reuse of the Tarabish Factory requires a multifaceted approach that emphasizes environmental, social, and economic resilience. By prioritizing the conservation of original materials and architectural integrity, the project not only preserves historical authenticity but also minimizes waste and resource consumption, aligning with ecological sustainability goals. Moreover, engaging the local community in the rehabilitation process fosters a sense of ownership and connection to the heritage site, thereby enhancing its cultural significance and viability. This inclusive method can generate local jobs and promote traditional crafts, further embedding the factory into the socio-economic fabric of Fowah City. Assessing contemporary needs through a sustainable lens ensures that the factory's transformation into a multifunctional space will meet diverse community requirements while safeguarding its historical value. Thus, the Tarabish Factory exemplifies a successful model where heritage conservation and sustainability converge.

Table 3: The principles of sustainable heritage conservation in Tarabish Factory in Fowah City, Egypt. Source: Authors.

	The principles of sustainable heritage conservation	Explanation	Applying in The Tarabish Factory's, Fowah City	Explain	Availability in the historical building
1	Preservation of Cultural Significance	Maintain the historical values of heritage buildings. The building has architectural, historical, and cultural monuments that have been retained.	1. Ottoman era: The Tarabish factory dates back to the Ottoman era in the 19th century when it was one of the important centers of the Tarabish industry in Egypt. 2. Traditional industry: The factory is part of the industrial heritage in Egypt, where Tarabish was an integral part of the country's traditional uniform. 3. Historical figures: The factory was associated with important historical figures and events, thus enhancing its historical value as a witness teacher at important times in Egypt's history.	 *Figure 5: The Tarabish Factory in Fowah City from the Ottoman era. Source: (youm7.com)*  *Figure 6: Elevation of Trabish factory. Source: Authors*	✓
		Maintain architectural values of heritage buildings.	1. Ottoman style: The factory features its unique Ottoman architectural style, including arches, decorations, and columns. 2. Traditional construction: reflects the use of traditional materials and old construction techniques used at that time. 3. Unique design: The unique architectural design of the factory makes it an important example of the industrial architecture of that era.	 *Figure 7: Arches, decorations, and columns in.The Tarabish Factory in Fowah City from the Ottoman era. Source: (youm7.com)*	✓

	Maintain the cultural values of heritage buildings.	1. Artisanal Heritage: The factory is part of Egyptian Artisanal Heritage, where Tarbush was a symbol of cultural and social identity. 2. Cultural influence: Tarabish had a significant influence on Egyptian and Arab culture, and was a symbol of social relevance and standing. 3. Intangible heritage: Plant is part of the intangible heritage associated with traditional handicrafts and their manufacture.	 *Figure 8: Tarbush Al Qersh Factory. Source: Waheed sobhi on Twitter – Artofit*	✓
2 **Minimal Intervention**	Intervene as little as possible to preserve the original fabric of the building as No extraneous changes were made to the building and its original condition was retained.	No systems that would have altered the factory's appearance have been applied.	The photo illustrates that no interventions were made that altered the structure or  *Figure 9: Current shape of the factory. Source: Bachelor's degree 2018 ,Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.* shape of the building.	✓
3 **Use of Sustainable Materials and Techniques**	Environmentally friendly conservation materials and techniques that reduce ecological footprint such as local materials, reducing waste, and choosing energy-saving solutions have not been used.	1. Recycled Materials: Recycled and local materials were not used. However, the original materials, primarily brick, remain intact. 2. Eco-friendly Techniques: Implementing techniques that reduce environmental impact did not apply.	 *Figure 10: Material of the factory's facades. Source: Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.*	× ×

4	Energy Efficiency	Energy efficiency in heritage buildings has not been enhanced to reduce their environmental impact.	Energy-efficient Lighting: LED lighting that reduces energy consumption was not installed.	The image shows that energy efficiency in heritage buildings has not been enhanced by insulation or energy-saving lighting.  *Figure 11: Non-insulated facade of the factory. Source: Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.*	×
			Insulation to improve thermal performance was not installed.		×
5	Adaptive Reuse	The adaptive reuse of the factory has not been done and transformed for new uses that ensure its continued relevance, preservation, and preservation of its historical and cultural integrity.	Cultural Center: No parts of the factory have been converted into a museum, cultural center, or other appropriate use.	 *Figure 12: No adaptive reuse of the factory or using its spaces as community spaces. Source: Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.*	×
			2. Community spaces: No spaces have been created for community events and educational purposes.		×
6	Long-Term Maintenance and Management	No ongoing care and management practices have been developed for the plant to ensure that it is maintained over time.	Maintenance Plan: There is no schedule for regular maintenance and inspections.	 *Figure 13: Lack of interest in the factory. Source Bachelor's degree 2018 , Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.*	×
			2. Funding: There is no secure funding for long-term preservation projects.		×
7	Community Involvement	The community was not involved in the conservation process to ensure social	1. Community workshops: Local people were not involved in workshops and conservation activities.	-	×

	relevance and support.	2. Outreach programs: No community education programs have been conducted on the importance of the plant.		×
8	Ensure the conservation project is economically sustainable.	1. Tourism: The factory was not promoted as a tourist attraction.		×
		2. Local crafts: support local craftsmen by providing spaces for artisanal production and sales.	 	✓
Economic Viability				
		Total Points		**5/16**
		Percentage		**31.25%**

Figure 14: Local crafts. Source: Bachelor's degree 2018, Department of Architecture, Faculty of Engineering, Delta University of Science and Technology and authors.

6. PROPOSAL OF TARABISH FACTORY'S ADAPTIVE REUSE

The Tarabish Factory in Fowah City, a traditional producer, is being repurposed as a cultural center, supporting regional artists, promoting traditional crafts, and generating revenue, highlighting the importance of integrated planning for sustainable economic growth. Future projects can involve turning the manufacturing space into workshops and markets, further integrating the local culture into the community, and making sure that construction meets environmental requirements(Damir et al., 2024). The Tarabish Factory in Fowa, Egypt, may be best adapted as a culture and history museum or a cultural center for handicrafts as shown in the following tables.

Table ٤: Transforming the Tarabish Factory into a museum or handicrafts center and their suitability as alternatives. Source: Gathered from (Damir et al., 2024) by authors.

	Culture and History Museum	Cultural Center for Handicrafts
Preserving Cultural Heritage	The museum can illustrate the history of Trabish production in Egypt and its change throughout time. This would highlight an essential aspect of Egypt's industry past, which stretches back to the era of Muhammad Ali Pasha.	Developing the factory into a cultural crafts center would focus on maintaining traditional crafts while supporting craft education around the community's young, building a relationship between the past and present while ensuring that skills are handed down to future generations.
Tourist Attraction	Egyptian history and culture would be a major attraction for both local and international tourists, and the heritage museum would be a popular tourist destination.	Interactive seminars that educate tourists on traditional crafts could be part of the crafts center, which could improve tourist engagement and provide a sustainable revenue source for the local population.
Preserving Local Identity	The Tarboush Factory is a heritage building that is still cultural and historical, and transforming it into a cultural landmark maintains its original identity and enhances the sense of belonging among the local community.	The local economy is bolstered by projects like these that generate new job opportunities in tourism and crafts.
Educational Function	Schools and universities could benefit from educational programs offered in the museum, which enable students to study Egypt's history and traditional industries.	Through the conversion of the building into an educational center, the local community can learn traditional crafts, which will help spread knowledge and preserve endangered craft skills.
Sustainability of the Building	The long-term preservation and prevention of further degradation can be achieved by repurposing the building in ways that respect both its community and heritage functions. The building's modern functionality is maintained while preserving its historical integrity through adaptive reuse, which ensures it remains a useful asset to the community.	

6.1 TARABISH FACTORY AS CULTURAL CENTER FOR HANDICRAFTS

To transform the Trabish Factory into a cultural center for handicrafts, a proposal has been developed. This proposal involves dividing the center into functional zones, each designed to support various activities associated with local and artisan industries. These zones aim to preserve and showcase the heritage of the area, facilitate visitor movement, and provide an educational and interactive environment. The proposed zones are shown in the following.

6.1.1 Description of Zoning

The proposed design aims to create an integrated visitor experience that merges educational and interactive elements with handicrafts. This design facilitates effective visitor management, ensures orderly service delivery, and maintains the heritage identity of the Trabish Factory while modernizing it to function as a comprehensive cultural center for the community. The following table outlines the zones designated for the adaptive reuse of the Trabish Factory.

Figure 15: Plans of Proposal of Tarabish Factory as a cultural center for handicrafts. a. current condition of Tarabish Factory. b. Proposed plan of the first floor. C. Proposed plan of the second floor Source: Authors.

Table 4: Zones in the proposed adaptive reuse of Trabish Factory. Source: Authors.

	Zoning	Elements	Description
1	Entrance and Reception Area	Reception desk, information screens, brochures and a map of the Centre.	Welcome visitors and provide information about the center and available activities.
2	Heritage Exhibition Zone	Archaeological exhibits, induction panels, interactive screens, and examples of tools used in those industries.	*Showcase the history of the Tarabish industry and other local industries characterized by the region*.
3	*Craft Workshops Zone*	Working areas equipped with tools and materials, with spaces for groups and participants in workshops.	Offering interactive workshops for visitors to learn handicrafts, such as Tarbish and other crafts
4	*Educational Zone*	Classrooms, workshop spaces, audiovisual and educational equipment.	Educational programs and curricula on cultural heritage and handicrafts for children and adults
5	*Library and Research Center Zone*	Library, computers, and archive of visual and audiovisual materials.	Provide research sources, books, and references on heritage crafts and local industries, to be a reference for students and researchers.
6	*Live Demonstration Zone*	Display platforms equipped, seats for the public, sound and lighting system to display the letter directly.	Make live performances of craftsmen showing how to produce tarabish and other craft products.
7	*Administration Zone*	Administrative offices, craftsmen's offices, and facilities for the services of the Centre.	Centre Management and Operations Organization.

6.1.2 Facades of Tarabish Factory in the Proposal

A renovation of the façade is part of the planned adaptive reuse of the Tarabish Factory as a Cultural Center for Handicrafts, which aims to achieve a balance between heritage preservation and contemporary usefulness.

- Preserve Historical aspects: To preserve the building's historical identity, the facade design will keep important architectural aspects such the original brickwork, Ottoman-style arches, and decorative motifs.

- Incorporate Contemporary Materials: To build new, useful spaces like entrances, show windows, and skylights, use sturdy, sustainable materials like steel and smart glass. This will ensure energy efficiency and improve natural illumination.
- Incorporate Artistic Displays: Provide areas outside for the display of traditional crafts and artwork to foster a welcoming atmosphere and highlight the building's role as a cultural hub.
- Accessibility and Visitor Flow: Provide easily accessible walkways and entrances to help guests move through the center's various zones in a convenient and safe manner. 5. Green Elements: To promote sustainability and improve the facades' visual appeal, incorporate vertical gardens or green walls to merge natural aesthetics with the urban surroundings. The goal of this proposal is to bring together the old and new in a harmonious way, respecting the building's historical significance while modifying it for modern cultural and communal purposes.

a

b

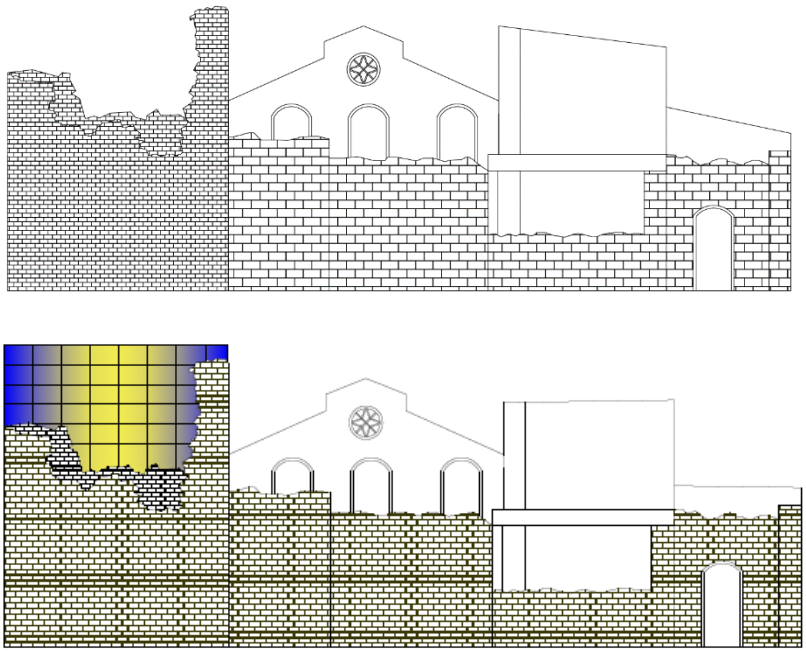


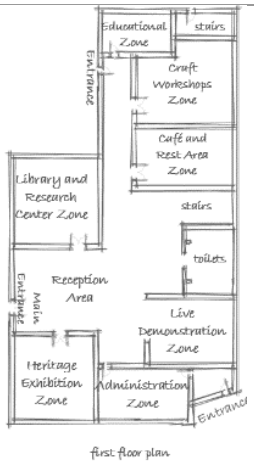
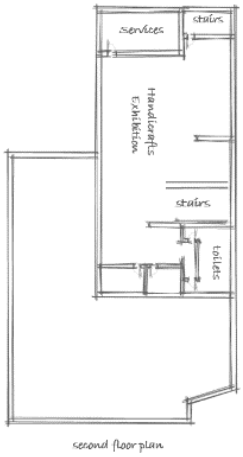
Figure 16: Trabish Factory facade before and after the proposal. a. Before proposal. b. After applying the proposal. Source: Authors.

The adaptive reuse of the Tarabish Factory involves a selection of materials that promote sustainability, preserve historical significance, and create a comfortable visitor environment. Key local materials include the original red brick, which reflects the factory's Ottoman architectural style, and locally sourced wood for doors and windows, enhancing traditional aesthetics. Sustainable practices involve using recycled brick, low-carbon concrete, and non-toxic paints to minimize environmental impact. Smart materials such as smart glass for temperature control, advanced insulation for energy efficiency, and smart lighting systems will further enhance functionality.

6.1.3 Applying Sustainable Principles of Heritage Conservation to the Proposal.

Table 5: The principles of sustainable heritage conservation in Tarabish Factory after the proposal of adaptive reuse. Source: Authors.

The principles of sustainable heritage conservation	Explanation	Applying in The Tarabish Factory's, Fowah City	Proposal of adaptive reuse of in The Tarabish Factory's, Fowah City	Availability in the heritage building

1	Maintain the historical values of heritage buildings. The building has architectural, historical, and cultural monuments that have been retained.	1. Ottoman era: The Tarabish factory dates back to the Ottoman era in the 19th century when it was one of the important centers of the Tarabish industry in Egypt. 2. Traditional industry: The factory is part of the industrial heritage in Egypt, where Tarabish was an integral part of the country's traditional uniform. 3. Historical figures: The factory was associated with important historical figures and events, thus enhancing its historical value as a witness teacher at important times in Egypt's history.	a  b  c 	✓
	Maintain architectural values of heritage buildings.	1. Ottoman style: The factory features its unique Ottoman architectural style, including arches, decorations, and columns. 2. Traditional construction: reflects the use of traditional materials and old construction techniques used at that time. 3. Unique design: The unique architectural design of the factory makes it an important example of the industrial architecture of that era.		✓
	Maintain the cultural values of heritage buildings.	1. Artisanal Heritage: The factory is part of Egyptian Artisanal Heritage, where Tarbush was a symbol of cultural and social identity. 2. Cultural influence: Tarabish had a significant influence on Egyptian and Arab culture, and was a symbol of social relevance and standing. 3. Intangible heritage: Plant is part of the intangible heritage associated with traditional handicrafts and their manufacture.		✓

Preservation of Cultural Significance

Figure 17: Proposal of adaptive reuse of Trabish Factory. a. First floor plan b. second floor plan. c. Main elevation. Source: Authors.

2	**Minimal Intervention**	Intervene as little as possible to preserve the original fabric of the building as No extraneous changes were made to the building and its original condition was retained.	The structure of the building has not been compromised. Some internal modifications have been made and some light interior walls have been added. Materials have been added to complement the rundown exterior and built with smart glass materials in order to distinguish between old and modern materials and also contribute to the sustainability of the building.		✓
3	**Use of Sustainable Materials and Techniques**	Environmentally friendly conservation materials and techniques that reduce environmental footprint such as local materials, reduce waste, and choose energy-efficient solutions have been used.	1. Reused Materials: Reclaimed Wood: Reclaimed wood from local sources will be integrated into the design, further promoting sustainability. 2. Local Materials: The original red brick will be preserved to reflect the Ottoman architectural style, while locally sourced wood will be used for doors, windows, and interior details.		✓
			3. Eco-friendly Materials and Techniques: Sustainable materials include recycled brick, green concrete, natural paints, smart glass, advanced thermal insulation, and smart lighting systems to minimize resource consumption, reduce environmental impact, and optimize energy consumption.		✓
4	**Energy Efficiency**	Energy efficiency in heritage buildings has been enhanced to reduce their environmental impact.	Energy-efficient Lighting: LED lighting that reduces energy consumption is installed in the proposal.		✓
			Insulation: insulation to improve thermal performance is installed in the proposal.		✓
5	**Adaptive Reuse**	The adaptive reuse of the factory has been done and transformed for new uses that ensure its	A proposal has been developed to transform the Trabish Factory into a cultural center for handicrafts, involving the conversion of parts of the factory.		✓

		continued relevance, preservation, and preservation of its historical and cultural integrity.			
			2. Community spaces: spaces have been created for community events and educational purposes.		✓
6	**Long-Term Maintenance and Management**	The development of the ongoing care and management practices of the plant will be sought to ensure its preservation over time.	1. Maintenance plan: There is no schedule for regular maintenance and inspection. However, a schedule of maintenance will be sought under the supervision of the competent authorities		×
			2. Funding: There is no guaranteed funding for long-term conservation projects. However, funding will be sought through the economic return from the center.		✓
7	**Community Involvement and Social Sustainability**	The community was not involved in the conservation process to ensure social relevance and support.	1. Community workshops: Local people were not involved in workshops and conservation activities.		×
			2. Outreach programs: No community education programs have been conducted on the importance of the plant.		×
8	**Economic Viability**	Ensure the conservation project is economically sustainable.	1. Tourism: The factory was promoted as a tourist attraction according to the proposal of an adaptive facade.		✓
			2. Local crafts: support local craftsmen by providing spaces for artisanal production and sales, Through indoor and outdoor spaces designed.		✓
			Total Points		**13/16**
			Percentage		**81.25%**

7. FINDINGS

The Tarabish Factory in Fowah City is a prime example of a successful adaptive reuse project that combines heritage conservation with sustainable development. The factory's cultural, historical, and architectural values are well preserved, but there are deficiencies in energy efficiency, long-term maintenance, and community involvement. The factory scored only 31.25% of sustainable conservation principles, indicating a need for a

comprehensive strategy to improve sustainable conservation aspects and enhance community and economic involvement. This could help mitigate urban decay and foster a sense of place in Fowah City and beyond. The proposal for the adaptive reuse of the Tarabish Factory in Fowah City reveals significant advancements in aligning with sustainable heritage conservation principles. While the original assessment indicated considerable deficiencies, the proposed strategies have led to marked improvements across multiple categories. The factory in Egypt is set to undergo adaptive reuse, preserving its cultural significance and Ottoman-era significance. The plan involves minimal alterations to the original structure, using sustainable materials and techniques. The factory will be transformed into a cultural center for handicrafts, fostering social interaction and cultural exchange. The plan includes energy efficiency enhancements, LED lighting, and improved insulation. A long-term maintenance plan will be established, and community involvement plans will be implemented. The factory will also be promoted as a tourist attraction, supporting local craftsmen through dedicated spaces for production and sales. Overall, the updated assessment indicates a score of 13 out of 16 points, reflecting an impressive 81.25% alignment with sustainable heritage conservation principles. These results underscore the potential for the Tarabish Factory to serve as a model for similar projects throughout Egypt and the broader Middle East, integrating heritage conservation with contemporary urban needs and community engagement.

8. CONCLUSION

The examination of the Tarabish Factory in Fowah City reveals substantial gaps in the application of sustainable heritage conservation principles. While the factory has retained its cultural, historical, and architectural values, it faces significant deficiencies in several areas: minimal intervention, the use of sustainable materials and techniques, energy efficiency, adaptive reuse, long-term maintenance, and community involvement. Following the proposed interventions, the factory achieved an overall score of 13 out of 16 points (81.25%), a notable improvement from the previous score of 31.25%. This contrast illustrates the transformative potential of a comprehensive conservation strategy.

A holistic approach to sustainable heritage conservation is crucial for the long-term preservation of this historic site. This strategy should include the introduction of energy-efficient solutions, the adoption of sustainable materials, the development of adaptive reuse initiatives, and the establishment of regular maintenance and management practices. Moreover, engaging the local community in the conservation process is essential to secure social and economic support.

By addressing these critical areas, Fowah City can serve as a model for similar regions in Egypt and the Middle East, effectively balancing the preservation of historical fabric with contemporary urban needs. This approach will not only foster a sustainable future that honors the past but also support the aspirations of diverse communities, ensuring that heritage sites like the Tarabish Factory remain vibrant and relevant for future generations.

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