Journal of Engineering Sciences
Assiut University
Faculty of Engineering
Vol. 46
No. 6
November 2018
PP. 719 – 737

HERITAGE BUILDING ADAPTATION: DECISION-MAKING FOR CONTEMPORARY INTERVENTIONS

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Received 24 July 2018; Accepted 29 August 2018

ABSTRACT

Existing old buildings were considered as the city's culture reminder. By the time, they could be kept via adaptation for contemporary usages. That adopting considered the context of the environmental, social and economic idea of the prior eras, related to the building's life cycle, that guided by local solutions. This paper started with the adaptation process definition with an evaluation of a number of building's state to bring out the different potential outcomes for discussing the future adaptation possibilities, especially that known as "alterations and extensions". Therefore, by rethinking of the new addition's integration into the heritage buildings will support the heritage value and fit new functions to present innovative design process approaches in the field of heritage preservation's design. By analysing some case studies, the study achieved some criteria for designing the alterations and extensions by making them an effective component in the design of old heritage buildings. And finally applying these principles to demonstrate its efficiency.

Keywords: Adaptive Reuse, Alterations and Extensions, Building Intervention, In-Use Adaptation, Cross-Use Adaptation

1. Introduction

Heritage buildings were essential for transferring the social cultural identity to next generations. These buildings were adapted for different usages, which helped in creating new public buildings and useable places to yield more benefits from renewing an area in a contemporary way [1]. So, by modifying heritage buildings from industrial and manufacturing spaces to buildings centred on activities like; services, educational and cultural aspects to breathe new life into an existing heritage building. The design process of adapting buildings deals with building modification, extension, interventions and ability of changing its use that helped to develop the identity of the place or acted as a landmark, by adding a new layer without erasing former layers.

Some previous researches tended to analyse the reusing of buildings by means of software simulation that proposed another use for the building within its design style with minor interventions to preserve the building identity from being replaced [2]. Others developed a method with an approach for designing new additions by adding distinguishable parts from the old building that preserved its characteristics [3]. From the

used materials point of view, studies confirmed that many of the ancient used materials and components were no more available and had to be manufactured as special order besides, there was no guarantee that suitably qualified craftsmen would be available locally or even nationally [1]. Finally, by defending the idea of presenting the principles analysis and demonstrating the conserving systems as a powerful infrastructure for educating architectural students via E-learning process [4].

1.2. Research problem

Several levels of heritage building adaptation process caused challenges for designers, that needs contemporary interventions. Which raises the question; if the new parts should relate to the old building, or should it support its difference or development of the original building's appearance? So, to value the effectiveness of these additions, this research must focus on:

- The effectiveness of a design strategy to achieve new form;
- The opportunities that helped in giving heritage buildings new features.
- The principles that affecting adaptive reuse and additions' design of heritage building.

1.2. Research aims

The research focused on preservation strategies of buildings via exploring the building value and its relation with surrounding contexts, through three main objectives; **First**, the evaluation of structural knowledge, materiality, strategies and tactics of adaptation in architecture. **Second**, investigating logical issues that had been taken into consideration during the design process of the new addition. **Third**, intended to form a guide for architects during the decision-making process to evaluate these projects.

1.1 Research Methodology

Through a Qualitative process, the study explained and discussed the affecting factors of adaptation principles and decision-making to identify strategies for heritage building's adaptation, that helped in analysing some case studies with variable additions, to obtain proposed adaptive reuse principles to verify the compatibility with heritage buildings, as seen in Fig.1:

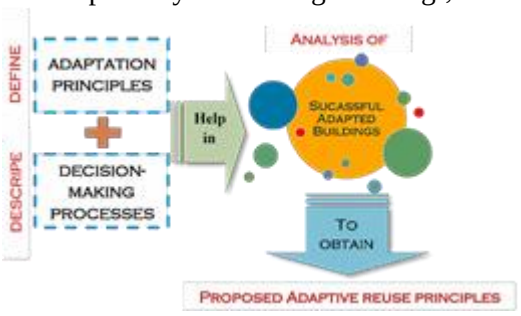


Fig. 1. The proposed methodology

2. Definitions

2.1. Heritage building and heritage conservation

Heritage building was a building or a part of building which required conservation for historical, architectural, aesthetical, cultural, environmental or ecological purposes [5].

Heritage Conservation of existing historic buildings by giving them a 'second life' via reconnecting them with surrounding society for providing real benefits to property owners, businesses and community. Which didn't mean freezing the building in time but seek to increase the buildings' value by keeping their original built form and architectural elements, investing in our community that rewards us today and leaves an invaluable resource for future generations [6]?

2.2. Adaptation and building adaptability

Adaptation was derived from the Latin 'ad' (to) 'aptare' (fit), that referred to 'change of use', maximum 'retention' of the original building structure and extending the property's 'useful life'. There were other terms such as renovation, adaptive reuse, refurbishment, remodelling, reinstatement, retrofitting, conversion, transformation, rehabilitation, modernization, re-living, restoration, revitalization, and recycling of buildings to define adaptation activities. From the usage perspective, the building adaptation occurs by 'within use' that kept its original usage, and 'across use' that changed the original use to another one [7].

Consequently, building adaptation was "any work on a building to change its capacity, function or performance", or, "any intervention to adjust, reuse, or upgrade a building to suit new conditions or requirements".

However, building adaptability was the building ability to occupy minor and major changes, through main five criteria: 1) *Convertibility*; allowed for having changes in use that was viable economically, legally and technically. 2) *Dismantlability*; enabled to have demolishment in a safe, efficient and speedy manner. 3) *Disaggregatability*; permit to reuse or reprocess the materials and the components dismantled. *4) Expandability*; increasing the volume or the capacity of the building by having addition floor or extension in either direction. *5) Flexibility;* helping in reconfiguring the layout and made new one with more efficiency [8].

2.3. Scales and levels of building adaptation

There were three different scales of building adaptation each one had sub-levels which were; Firstly, ***Small-scale adaptation*;** involved the surface's improvement, and extensions in minor areas, or structural works. That had **level 1:** with minor adaptation. Then, ***Medium-scale adaptation*;** made a change in the building structure's capacity, through many structural alterations, extension in a lateral or vertical direction, insertion or removal of walls and floors, had **level 2:** was 'alterations' adaptation, such as fit-outs to individual floors. Finally, ***Large-scale adaptation***; it held extreme changes by extensive remodelling works planned, changing the usage and decreasing or increasing the building capacity, had **level 3**: 'change of use' adaptation and **level 4**: major alterations and possible extensions known as 'alterations and extensions.' [7] [8].

3. Decision-making concerns in building adaptation

Building adaptation decision-making process was complex, due to many involved stakeholders, which could be investors, producers, developers, regulators, users and marketers. Each of decision-makers took different viewpoints in making decision, and at different stages during the process and each had different degrees of influence, which affected all the following decisions.

From the stakeholders' point of view, there were available six options as follows: **Option one**; change the use with minimum intervention due to the 'building flexibility'.

Option two; adaptation with minor changes, while **option three**; required a higher degree of intervention that referred to 'refurbishment' or 'retrofitting'. **Option four**; had selected demolition, and **option five**; was the extension of the facility. Finally, **option six**; was demolition and redevelopment that was selected when the social, economic, environmental, physical and regulatory conditions of the building were at the end of its life cycle [7]. The arguments for and against building adaptation were classified under social, economic and environmental factors, to identify a 'successful adaptation'. These elements aided to help and to guide in the decision of undertake the adaptation process.

3.1. Environmental elements

The embodied energy was an environmental benefit of adapting buildings. The reserved embodied energy made the project much more environmentally than fully new construction [2], by involving less material use (i.e. resource consumption), less energy for transportation, less energy consumption and less pollution during construction [8]. Moreover, many older buildings used massive construction in their external envelope, which could reduce energy consumption in heating, cooling, and carbon emissions, also the social and economic advantages of recycling [9].

3.2. Social elements

The social and cultural values of the heritage buildings were vital. They represented the memory of the society, and provided status and image to the society by using of massive and highly crafted materials [9]. By retaining, rethinking and reworking an existing building this history could continue in a physical form, and increased the value of memory which served to create sense of place [10]. So, by conserving and reusing these buildings, the future generations will benefit from this conservation and reuse of heritage places [2] which considered a positive social impact for stakeholders.

3.3. Economical elements

Adaptation had to be economically viable to be successful. An economic argument was "it was often cheaper to adapt a building rather than demolish it and build newly". Embodied energy savings from not demolishing will increase with the expected rise in energy costs in the future [2]. Besides, it took half to three-quarters of the needed time to demolish and rebuild the same floor area [9]. However, not all projects were economical and adaptation costs could exceed a comparable with new building, so stakeholders need to consider this early in decision making. These decisions depended on whether the stakeholder was a user or only an owner because developers were not concerned with life cycle costs but rather focus mainly on capital cost. On the other hand, users and occupants were concerned with building operating costs, and on the financial returns [7].

4. Adaptation and interventions in architecture design

Adaptation of the existing building was a vital task for architects; it needed unique skills and understandings than the conventional design. Thus, such projects required further tools to manage with; diverse kinds of creativity, the design tools in design process and its physical attributes. The adaptation's architectural design required to consider both the original and renovated building by its actual and modern usage with its physical structure. The most important factor in the renewed building design was the relationship between the old and the new building. There were three strategies of building reuse based on the extent of integration

between the host building and the added elements. These strategies were intervention, insertion, and installation. This research will focus on the intervention strategy which defined as; the existing structure undergoes radical transformations so it was no longer exist independently, and was completely integrated [11].

4.1. Physical attributes

Many studies had identified the building physical features as an important consideration during adaptation. These features were; construction type, used material, plan shape, etc.…... as shown in Table (1).

Table 1.
The Considered Physical Elements during Adaptation [7] [Author]

Physical attributes	Features
Construction type	Steel framed buildings were more easily adapted than concrete structures due to the ease of shaping.
Plan shape	Irregular plan shapes were difficult to be adapted to suit a wider range of new users.
Service location	- Affected the division's ability of space and how services could be delivered to various parts - The central location will give huger scope for subdivision and minimize the corridor and circulation' space.
Site features	- Whether a building was attached to one or more sides affected the ease or the desirability of adaptation. - Less attachment to other buildings helped in greater adaptation speed
Entrance and exit points	Number of entry and exit points affected on adaptation potential, more access points a building had, the extra flexibility for adaptation.
Floor clear height	Floor-to-ceiling heights were essential, that building services might be adjusted in ceiling voids or raised floors, with altered land used requiring different heights.
Building width	- A width up to 15–17 m was more adaptable; that able to contain a range of space shapes and user needs more frequently. - The span between the structural columns on the floor plate affected the ease of adapting for both new and original uses.
Modular flexibility	- Focused on the buildings' features which shaped them easier to change and adapt modularity. - Modules or narrower units that could be rearranged, replaced, combined or interchanged easily.

4.2. Adaptation design guides

Adaptation design guides divided into two phases; 1) *The initial design* with its primary function phase; and 2) *The modern structure*, with its new function phase. This led to three stages of formal analysis: 1) **Original building form** (initial stage); 2) **Reshaped building** form (final stage); and 3) **The transformation** from the primary stage to the final stage in terms of tactics, strategy, and type of intervention [4].

4.2.1. Interventions and building value

Interventions in heritage buildings should be preceded by a study of the building's contextual aspects (i.e. primary job, location, structure and architect), and the building's

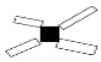
architecture elements space, structure and services to decide the possible changeability of the building. This method assumed three levels of time: origination, aging and continuing. In these layers of time, the building's technical state and lifespan were the most notable features of the building aging, and thus it was necessary for the continued life of the building. New potentials were formed after analysing buildings, to propose options for irregular ways of living, working and recreating, these options were studied before starting the design process of buildings to keep in continuation rather than being lost to decay. This surplus layer of time will create continuity and extra quality to adjust functions in the building [7].

4.2.2. Types of intervention

Types of adaptation in architecture had various types that depended on its built mass' features, place, and function. It could be categorized into; internal and external interventions, each one had several cases and function for applying.

Table (2) clarified the possible interventions and the specific conditions for buildings and sites (the black parts indicate the new interventions). These different types designed for controlling the spaces and applied to refine the details of the intervention design, all of the cases were considered to provide the most viable structure and design [12].

Table 2.
Types of building interventions [9][12] [Author]

	Dicription			
Interior Interventions	 Consolidator: linking the building in a dynamic way	 Gate: a doorway by interstitial space between two blocks.	 Plaza: creating an underground space	 Knuckle: join many edges at any angle around a centre
	 Infill: new construction in void areas where the blocks were scattered	 Misalignment: a created new block without relation to the site context	 Wall: new block to form a continuous wall in the interstitial space.	 Marriage: version of a consolidator, its edges match the width of its elements
	 Alignment: like consolidator, but with the same block width	 New interior in an old shell: A new intervention was created inside an old structure.	 Zipper: a teeth project from a single block on each side, their edges is joined by a new element.	
Exterior Interventions	 Umbrella: A new structure above the existing buildings	 Transition: a slop of new block roof was angled to relate two blocks top' corners	 Hat: a new volume or structure in the existing site	
	 Boundary: a new wall creates an existing boundary or a central courtyard.	 New face: a block on the courtyard corner or a large building to support facades.	 Edge reinforce: a new face form with an irregular complex surface	 Space maker: a combination of boundary and a new face
	 Corner: a wall shape, but the blocks position was angled	 Feature building: a complicated shape inserted in the void area to bring a focus	 Bridge: new structure gave a passage between two blocks.	

4.3. The Architects' techniques in building additions

Contemporary architects were of two minds: first, that an addition should have its own stylistic integrity to be determined by the architect. Second, that an addition needs to respect and somehow value the visual integrity of the existing historic building. By realizing and analysing of the existing building values (architectural value, value in use, historical and cultural value) that made the building fit for new use were influencing the architect to conversion. The main challenge for architects was how to integrate the existing historic building with a new contemporary architectural design. The architects' approach was to redesign and redevelopment of a building by a methodical way of studying and analysing this specific building, to conclude a design for conversion, that based on possibilities and ideas of possible future functions and designs for the building extensions, using essential data of typology, construction, space use and dimensions of both the existing building and the possible new functions to find a design that suits the building and improves the building's architectural quality [7].

4.4. Strategies of additions between differentiated and compatible in heritage buildings

When a designer planned new construction in a historic building, he might take one of four strategies, which represent "differentiated" yet "compatible" designs; 1) *literal replication*, 2) *Invention within style*, 3) *Abstract reference*, and 4) *Intentional opposition* [13,14] as seen in table (3).

Table 3.
Strategies of Additions [14] [Author]

	Description
Literal Replication	Its prioritization was compatibility and minimizes diversity to sustain the existing character so long as the historic elements replicated. Many historic preservation officials opposed replication, believing that new construction must allow a contemporary impression.
Invention Within a Style	It was not replicating the original design but added new elements in either the same or a closely related style, to sustain the sense of continuity by achieving a balance between differentiation and compatibility, but weighted to the latter. That leaded to new design that had both differentiated and compatible with respect to its pre-existing context.
Abstract Reference	It designed to make reference to the historic features while avoided working in a historic style. Also, it looked for balancing differentiation and compatibility, but tipped toward the former. This strategy was difficult to execute because it required creativity and skill. It was considered a modern design in which the new and old compatibility was optional by decreasing of composite form to abstract shape.
Intentional	It was one of mindful opposition to the context by changing its character with visible contrast, via prioritizing differentiation at the expense of compatibility. Sometimes contrast was the proper response to a context that was weak or insufficient, so this strategy might be used to repair the historic setting brought about by previous insensitive or oppositional interventions.

5. Case studies

5.1. Criteria of selection

The selected projects were listed by name, location, remodeled architects, original and new use. They were selected according to the following criteria; **first**, lay in the option three from stockholders' perspective *{a higher degree of intervention}*. **Second**, were in the large scale adaptation *{alternation and extensions}*. **Third**, obtain *{Intentional opposition}* from the differentiated and compatible viewpoint, with variable intervention types either with cross-use or in-use buildings. **Fourth**, each example was analysed by; **1)** the intervention type, **2)** its physical attributes, **3)** the used materials and **4)** the reason of adaptation, to obtain the adaptation principles that should take depending on the building situation, as seen in Table (4).

Table 4.
Case Studies Analysis [Author]

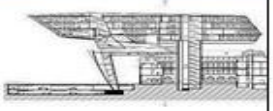
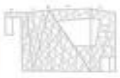
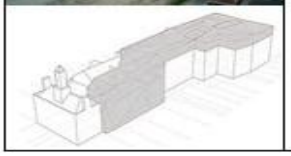
Cross used projects	Extension Features
 	• Antwerp Port House, Zaha Hadid Architects • Fire station into a new headquarter, 2016 [15][16] - Umbrella intervention - New volume floated above the old building. Respecting each of the old facades and completing the upright of the original tower design. - Using three sculptured concrete pillars, with a triangular glazed surface for smooth curves like waves. - Glazed elevations reference the city's diamond trade, acted as a landmark, giving panoramic views. (social, economic).
 	• Moritzburg Museum, Nieto Sobejano Architects. • Castle into museum, 2008 [17] - Space maker intervention - Providing a roof to the initial open-air top floor, creating an additional exhibition area. - Steel main structure, with clear glazing façade. - Involves a new roof, considered as a large folded platform, which rises to enter natural light, and from which the new exhibition areas hang, contrasts with castle's existing irregular shape and high roof (environmental, social)
   	• Marksmanship Museum, Gnädinger Architects. • Old house into a museum, 2011 [18] - Gate intervention - The two new wings of concrete cladded by triangular motivated triangular folds. - Golden façade with copper alloy sheets with various sizes in an uneven pattern on a timber-framed structure. - To create a new landmark, both partly rigid and partly organic, the golden skin was chosen in reference to the metal shiny surfaces of old weapons like armour, swords and shields, (social)
 	• Edwardian building, Rare Architecture, 2012 • Town hall into a hotel [19] - New face intervention - Added space for more guest rooms and facilities, merging the three unrelated elements into a single unit. - Steel structure, with double glazed curtain wall, screened by a parametrically designed ornamental skin from aluminium sheets via laser cut, in variable pattern degrees. - An ornamental screen facade tied the historic and modern buildings and developing user comfort via environmental performance, allowing creating an unusual abstract background to the original structure. (social, economic)

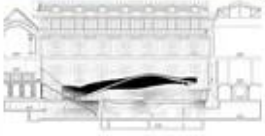
Table 4. (Continue)

Cross used projects	Extension Features
 	• CaixaForum Madrid, Herzog & de Meuron, 2008 • Power station into Art Centre [20] - Hat intervention - Add space for galleries, administrative offices and a restaurant in the upper levels. - Classified brick shell, using three main concrete cores, with oxidized cast-iron rusting steel plates cladding with a pattern fixed on some walls. - Extreme contrast between new and old architecture improved both, the new structure locks into the existing roofline, differentiated by colour and material (social)
 	• Rockheim, Trondheim, Pir II AS and Agraff AS. • Warehouse into Music National Museum, 2010 [21] - Umbrella intervention - An additional area in boxed roof sits on top and alongside of the warehouse, were clearly separate from the existing - Colourfully printed glass façade on a steel structure, illuminated with shifting colours at night. - The glass design was inspired by the museums' collection. Photorealistic images of Norwegian music album cover were printed across hundreds of glass panels; the additional area was located in separate boxes; one on the roof and one alongside, (social).
 	• Contemporary Jewish Museum, Studio Libeskind, 2008 • Power substation into museum [22][23] - Feature building intervention. - Two icicles like forms; one project above the roof, the second extends horizontally out of the south end. - Sparkling-blue stainless steel cladding panels were accurately detailed, containing the joints between the new metal skin and the old masonry one. - The shape was based on old symbolic letters, was a large education centre, that offer educational programs in conjunction (social)
In used projects	**Extension Features**
 	• Seydoux- Pathé Foundation, Renzo Piano,2014 [24][25] - Infill intervention. - Inserting a building into a historical city block for space recovering, for archives, a documentation and research centre. - External skin of translucent glass tiles envelops the entire structure, glass vault clads in perforated aluminium panels, and exposed parabolic wood arches (Glulam beams). - Five story glass hulls (organic shape) in the middle of a garden, respecting the surrounding buildings and increase the service, improve the neighbour's access to natural light and air (social, environmental).

Table 4. (Continue)

Cross used projects	Extension Features
 	• Maritime University, Kim Utzon Architecture, 2015 [26] - Feature building intervention - Folded plate cladding extension, act as a focal point. - Aluminium sheeting cladding, a symbol for the commonly metal sheet used in Swedish and Australian architecture. - Roof sheets colour was related to the original Tomhuset roof, acted as a hinge between itself and the original "Tomhuset", creating teaching and office extra spaces for an institution, (social).
 	• Dresden Museum, Studio Libeskind,2011 [27] - Feature building intervention - Creating a bold interruption by pointed steel and glass part in the skin to create new galleries on five floors and a roof viewing platform. - Concrete and steel structure with transparent glazed cladding on a screen of thin steel rods supported on structural steel grid. - Structure with a sharp tip pointed eastwards, to the firebombs source dropped during the war, new façade's openness and transparency push through the opacity and rigidity of the existing building, (social).
 	• 3 Waterloo Street House residences, DKO, 2016 [28] - Hat intervention. - Metal perforated 'floating' box of apartments on the existing building. - Fully glazed façade, pixelated perforations in the powder coated black metal facade to allow solar access and cross ventilation, and referenced the brick patterns below. - The design referenced the brick patterns and simple surroundings geometries, a 'shadow line' between the two levels was made to appear like it hasn't been touched, kept and respect the culture of the area by giving a bit of history to the site. (social, environmental, economical)
 	• Royal Ontario Museum, Libeskind, 2007 [29][30] - Feature building intervention - Five intersecting volumes, which were significant of crystals, solving complex functional issues. - Main steel structure, with new piled foundations. Composite steel and concrete floors and glazed cladding creates a transparency and form an artistic unity. - The intersection of two crystals formed new galleries, created a void known as the Spirit House, extended the environmental control in much of the new and original buildings, as a focal point for education, exhibition and community, (social).

Table 4. (Continue)

Cross used projects	Extension Features
 	• The Forum, Studio 804, 2015 [31] - Space maker intervention. - Created an interaction place for students - The skin was made of two separate walls of insulated glass, provided by cedar louvers helps to improve indoor air quality. - Built by students of the Architecture Department of Kansas University to meet the LEED v2009, to provide a memorable expression of the new technology importance within the urban context, (social, environmental).
 	• Islamic Arts Department at Louvre Museum, Mario Bellini and Rudy Ricciotti, 2012 [32][33] - Plaza intervention. - Two of its three floors were underground gallery beneath an undulating glass roof. - Free-form lattice steel tubes, with tessellated insulating double glass triangles, covered in gold and silver aluminium mesh, and triangular polished aluminium honeycomb panel. - Like a foulard that waved in space by the wind, almost touching the ground of the courtyard at one point, but without totally affecting the historic facades. (Social).

5.2. Summary of findings from case studies

These additions focused more on the "sense of time" than the "sense of place" to attend of "our time", and were added in a way that was unique from the historic fabric to emphasize on the concept **"**Contrast: Respectful Difference". Besides, each building tried to combine tradition and modernity in one building to add a new layer of details and functionality. Accordingly, after analysing case studies from many perspectives; such as the place of intervention, the used materials, the reason for addition, it could be noticed some points that helped in proposing the adaptive principles:

According to the place of intervention; most projects tended to design external interventions for more flexibility in adaptable due to the building size could be enlarged for new uses and occupiers, especially feature buildings (to emphasize the concept of uniqueness).

From the used material's perspective; most of the buildings used steel in constructing the additions either as a structure or a cladding material with a modern appearance. Or using glass in the cladding to complete the concept of transparency and add a contrast with the historic solid initial structure.

Finally, by the reason of addition; almost all buildings had extensions to serve the social benefits to increase its cultural value, followed by the economical reason, then for the environmental reason.

6. The proposed adaptive reuse principles

With the aim of retaining the historical buildings' personality and unique importance, thus conservation was the main way of caring and dealing with the changes. Also, heritage buildings were a unique resource of ethics, so by losing or corrupting of their unique values

couldn't be restored and hardly be recovered. Consequently, the following principles were proposed to be used to well adaptive reuse of historical buildings, that could be grouped into concept design, Decision making options, and the added value's elements, as seen in Fig. 2, which helped in analysing the previous case studies, as seen in Table 5:

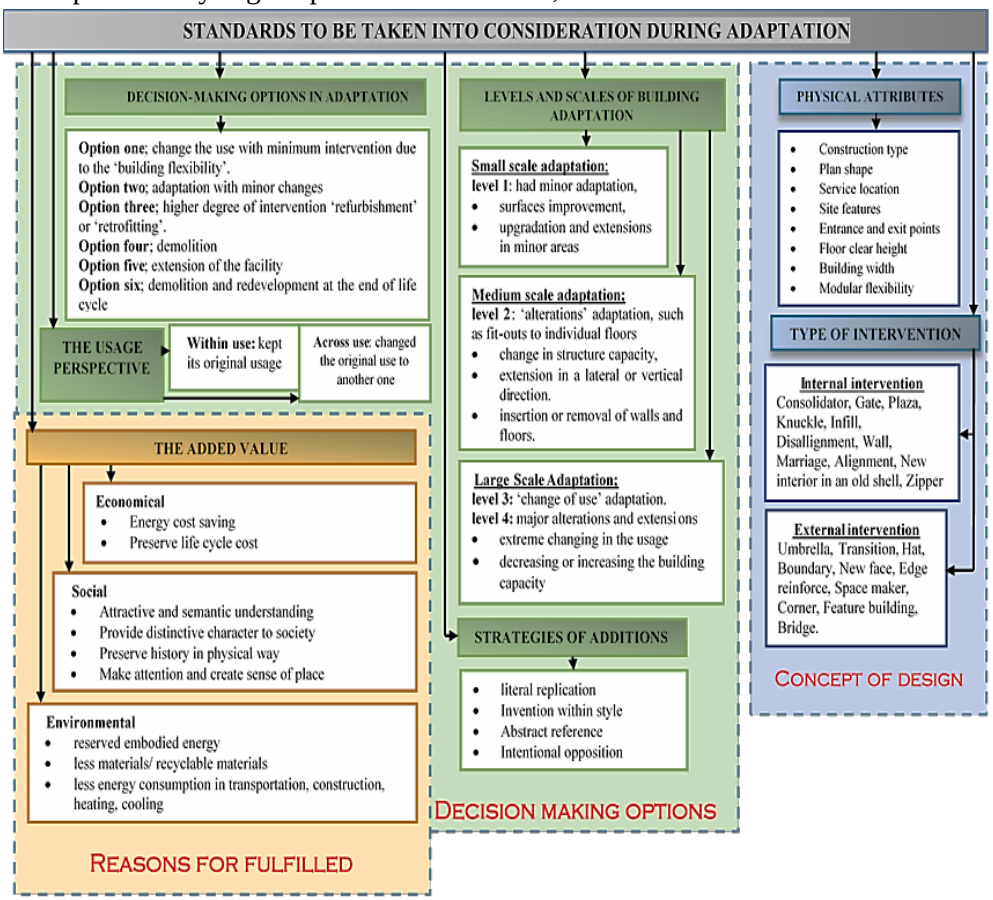


Fig. 2. Proposed Adaptive reuse principles

Table 5.
Applying of Proposed Adaptive reuse principles on case studies

STANDARDS TO BE TAKEN INTO CONSIDERATION DURING ADAPTATION				Case Studies Projects													
				Antwerp Port House	Moritzburg Museum	Marksmanship Museum	Edwardian building	Caixa forum	Rockheim, Trondheim	Contemporary Jewish Museum	Seydoux-Pathé Foundation	Maritime University	Dresden Museum	Waterloo Street House	Royal Ontario Museum	The Forum	Islamic Arts Department
Concept of Design	Usage Perspective			In used							Cross used						
	Decision Making Options	Level or Building	Level 3: change of use adaptation. level 4: major alterations and extensions	√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Decision-Making Options [Option Three] higher degree of intervention		√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Strategies of Additions [Intentional Opposition]		√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Physical Attributes	Construction type		√	√	√	√	√	√	√	√	√	√	√	√	√	√
		Plan shape			√			√					√				√
		Service location		√				√	√					√	√	√	
		Site features									√		√				
		Entrance and exit points				√		√		√	√				√	√	
		Floor clear height		√	√												
		Building width				√	√	√						√		√	
		Modular flexibility		√				√					√	√		√	√
	Type Of Intervention	Internal				Gate					Infill						Plaza
		External		Umbrella	Space Maker		New Face	Hat	Umbrella	Feature		Feature	Feature	Hat	Feature	Space Maker	
Value	Economical			√			√							√			
	Social			√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Environmental				√									√		√	

7. Case study (Prince Youssef Kamal's Palace)

Prince Yusuf Kamal's Palace was one of the most beautiful palaces of Mohammed Ali's family, and his palace had merged European Architecture in Eastern Architecture (Arabic Islamic). The palace was built in 1908 and was designed by the famous royal palace architect "Antonio Lasciac", one of the most famous architects who came to Egypt at the end of the 19th century and the beginning of the 20th century. Consequently, due to the effect of the expansion of urban buildings, this palace was a model of the steadfastness of aesthetic values in the face of the attack of modern civilization.

7.1. History of the structure

The construction of the palace took 13 years; and considered an architectural masterpiece with a facade of a garden of about 14 acres. Besides, the architectural design was a Renaissance European style, from the palace façade, the western influenced on

columns and floral motifs, the open dome was the highest node that looked closer to the sun disk, as seen in Fig. 3, 4.

Fig. 3. The main elevation

Fig. 4. Satellite map of the palace

7.2. Problem definition

Today the palace was turned to the "Desert Research Center" (DRC) that belonged to the Minister of Agriculture and Land Recommendation since 1954. From this date, there were many added buildings that used to facilitate the center's work, such as offices, laboratories, and storage places. And the palace was used as the center's central administration, as seen in Fig. 5.

Fig. 5. Recent images of the palace and the "Desert Research Center"

7.3. Building analysis

The main facade had an outer ladder preceded by a circular shape. Then, the main entrance leads to the reception hall, which faced the columns of the second floor with crowns that had an influenced European decoration. Moreover, the lobby was topped by a luxurious marble staircase, which looked firstly more spacious and then slopped gently separated into two ends leading to the second floor. Besides, the ceiling of the lobby was a rectangle space with a balcony facing the palace's garden, as seen in Fig.6.

Fig. 6. Some details of the palace

7.4. Adaptive reused proposal

The new architectural solution should conserve the personality of the building. Due to the palace was used in an inappropriate manner for many years and demanded great conservation work, thus the task was to hold the character of the original palace and linked it with the added buildings for avoiding demolition them to create new open spaces along with the previous use form.

With considering the proposed adaptive reuse principles, so the proposal offered a practical model for adaptive reuse to create new uses which were appropriate to the palace's heritage importance. Consequently, the idea was inserting new useful elements that were efficient and contemporary, that helped to adapt existing buildings in socially and environmentally useful ways.

Fig. 7. Applying the proposed reused options

Mainly, the palace was planned to be a museum with some galleries' area to serve as a large exhibition space and some gift shops to provide great flexibility. The museum could be entered from the outside gate which directed the visitor to the floor level entrance, and the design proposed the utilization of the passageway from the main entrance for establishing of tourist bazaars. Moreover, some illuminations could be added via a large data-show to tell the history of the palace structure and the development's story that helped in improving structure's appeal as a tourist target, as seen in Fig. 7.

Fig. 8. The proposed new elevation concept

Then, the museum will divide within its original plan design without changes, according to sequence periods of time to represent the Prince Yousef's collectibles, such as in the library, the Arabic Music Hall, and the main dining room. Besides, the added buildings were planned to be painting workshops for children and adults, it will offer more spaces for practicing more activities, especially in drawings and music (which considered the prince's main hobby). So, this proposed design kept the external appearance and parameters of the original building and allowed for some external restructuring, as seen in Fig. 8.

By using the proposed adaptive reuse principles that have been respected to achieve a successful adaptation, as seen in Table 6.

Table 6.
Applying of the proposed adaptive reuse principles

Design Considerations				Case Study (Prince Youssef Kamal's Palace)	
Decision Making Options	Usage Perspective		Cross used	√	From a historical palace to a museum
			In used		
	Levels of Building Adaptation	level 3: change of use adaptation.		√	By changing the usage and increasing the building capacity
		level 4: major alterations and extensions		√	
	Decision-Making Options [Option Three] (higher degree of intervention)			√	
	Strategies of Additions (Intentional Opposition)			√	
Concept of Design	Physical Attributes	Construction type		√	Historical structure need carefully conserve,
		Plan shape		√	Respect the main plan design and focused on the main entrance.
		Service location		--	
		Site features		√	Utilize the garden paths as an open gallery that linked to the building
		Entrance and exit points		√	Strong focusing on the main entrance
		Floor clear height		--	
		Building width		--	
		Modular flexibility		√	Keeping the plan without change due to its regular module.
	Type Of Intervention	Internal			
		External		Feature	The added shape could be just a plan glass façade or a fluid organic glass envelop to represent some smoothness with some fritted patterns inspired from the prince collectibles, that contrast with the building fabric and save the continuity at the same time.
Added Value	Economical			√	New uses as art gallery retained some commercial functions and enhance public access.
	Social			√	Preserving the heritage value, and increasing the valuably of the space
	Environmental			--	

8. Conclusion

The main contribution of the research was the conservation the heritage building's values, by means of the adaptive reuse features of heritage buildings, that added and extended the building's life cycle and provided significant social and economic benefits to the society. Accordingly, the heritage building should have an acceptable accurate function, with minimal impact on its cultural importance.

Thus, after the theoretical study to reach the adaptive reuse principles and the means of decision-making of stakeholders, the research was reached some of main points that helped to develop the idea of these principles that could be taken in the consideration during the process of adaptation, which showed that social value was the most respected value to work on, followed by economic and environmental values. Each building included a philosophical concept to design its new addition, that may appear in the final shape or even in the used material which expresses its definite idea. The trend was to use materials that were installed, executed or disassembled easily such as glass or steel for less affecting the origin building structure's safety, to preserve it for the maximum possible extent.

Subsequently, by using the proposed principles, which were applied to one of the royal palaces, with taking into account the local requirements of the heritage buildings preservation. The proposal was trying to keep the current status of the palace and the added buildings, by turning it into a museum to fit the proposed cultural value and adding modern facades with light materials as glass and metal rods to preserve the actual value of the palace. Besides, it was trying to integrate the surrounded environment to ensure the integrity of the preservation principles.

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تكيف المباني التراثية: اتخاذ القرار لحياة جديدة معاصرة

الملخص العربى:

تقوم المباني التراثية القائمة كعامل تذكيري ثقافي للمدينة. ويمكن الاحتفاظ بها وبكفاءتها عن طريق التكيف مع الاستعمالات المعاصرة. ويتم دراسته من خلال السياق البيئي والاجتماعي والاقتصادي للحقب الزمنية السابقة، والتي تكون مرتبطة بدورة حياة المبنى. بدأت هذه الورقة بتعريف عملية التكييف وتحليل لعدد من نماذج بعض المباني لإظهار النتائج المختلفة والمحتملة لمناقشة إمكانيات التكيف المستقبلية، خاصة تلك المعروفة باسم "التعديلات والتوسعات". لذلك، من خلال إعادة التفكير في دمج تلك الإضافات الجديدة على المباني التراثية، ستقوم بدعم القيمة التراثية للمبنى وتساهم في تكاملها مع الوظائف الجديدة المقترحة، لتقديم أساليب عملية مختلفة لتصميم مبتكر في مجال الحفاظ على التراث. من خلال تحليل بعض حالات الدراسة، وصل البحث لبعض المعايير المساعدة لتصميم التعديلات والتوسعات من خلال جعلها عنصرا فعّالاً في تصميم المباني التراثية القديمة، وأخيرا محاولة تطبيق هذه المبادئ لإثبات كفاءتها.