

Adaptive Reuse(AR) of Historical and Heritage Buildings Through Concepts of Addition and Expansion

Zainab Abbas Munshed^{1*} and Ammar Saleh Ashour¹

¹ Architecture Department, Faculty of Engineering, Baghdad University, Baghdad, Iraq.

Abstract. With the emergence of significant changes occurring rapidly in all aspects of life, and their profound impact on job transformation and evolution, there is a necessity for adaptively reusing existing buildings (whether heritage, historical, or modern) to accommodate these new variables through the realization of expansion and addition concepts, whether horizontally or vertically, internally or externally. A set of global experiments has demonstrated various methods and strategies for adapting the reuse of different buildings, which were in urgent need of addition and expansion in various forms to meet the evolving requirements and emerging needs. These experiences can be studied and analyzed to derive key indicators that can be applied to future local experiments. The research adopts a descriptive and analytical approach by reviewing and analyzing previous studies first. It then studies the essential concepts related to the research (assumed building lifespan, expansion, addition, as well as adaptive reuse). Subsequently, a group of global experiments applying these concepts is studied and analyzed to extract essential indicators that can be applied to the local case study, represented by the historic Qishla building. The research concludes with a set of findings. Through the analysis of previous studies, the research identified the research problem as "the lack of knowledge and local studies and applications regarding adaptive reuse for historical and heritage buildings, even modern ones, through expansion and addition processes of all types used in them. The research emphasizes the importance of reassessing global experiences that practically achieved the concepts of addition and expansion and choosing successful strategies for future addition and expansion of local buildings in need of enhancement to meet new requirements and contemporary spirit. The study yielded several conclusions, among which is the acknowledgment that each building has an assumed lifespan (at the technical, functional, and economic levels) that requires adaptive reuse through horizontal and vertical expansion and addition, whether at the structural or spatial levels, above, inside, or adjacent to the building. The appropriate strategy should be selected for each building based on its function, chronological age, social significance, available space inside and around it, while preserving its value and style. This was observed during the analysis of the historic Qishla building in Baghdad. This study serves as a valuable resource for architects, urban development planners, and policymakers seeking to understand and implement adaptive reuse with thoughtful additions to buildings in their different contexts. The indicators derived from the research can also be applied to a range of Iraqi buildings in need of adaptive reuse.

1. Introduction and Literature Review

Historical and heritage buildings represent pivotal points in cultures around the world. These are sites that carry historical and cultural values, distinguished by a rich history and deep heritage. These places reflect their uniqueness through their architectural and artistic styles, as well as the events they witnessed and the temporal dimension associated with such types of buildings. They constitute a vital part of the cultural heritage that efforts are made to preserve. (Fileden, 1994, p. 17)

With significant changes occurring globally on social and cultural levels, historical and heritage buildings face challenges in preserving their identity while adapting to contemporary needs and accommodating these changes. Preserving these places requires careful balance between heritage conservation, on one hand, and accommodating modern developments and meeting the needs of today's societies, on the other.

Among the prominent challenges facing these buildings are neglect, the end of their functional lifespan, and the inability to keep up with modernity and technological advancements. Consequently, there is a need for continuous adaptation of historical and heritage buildings, especially in countries with limited experience in this field, such as Iraq, for example. (Grecchi,2022, p.4).

* Corresponding author: zainab.abbas1604a@coeng.uobaghdad.edu.iq

Many studies have addressed the topic from various perspectives. Some focused on the concepts of addition and expansion in buildings, while others delved into the concept of adaptive reuse. In the first axis, literature explored the effectiveness of addition and expansion in keeping historical and heritage buildings abreast of changes. Studies such as those by (Letzter -2022), (Erdogan -2021), (Almajdi -2020), (Alkinani - 2020), (Al-Fayadh - 2012) emphasized the importance of employing addition and expansion strategies to enable buildings, especially historical and heritage ones, to accommodate societal changes. The studies underscored the role of studying the history and architecture of these buildings to choose suitable addition types, maintaining their uniqueness and conveying their historical or heritage value to future generations.

Moreover, these studies examined different levels of the addition and revitalization process physically and morally, considering the role of architectural vision in determining these levels. They highlighted the impact of addition and revitalization actions in creating functional and expressive changes in existing buildings, emphasizing the relationship between historical and heritage buildings and contemporary ones when facing new requirements.

In the second axis, other studies emphasized the importance of studying the concept of adaptive reuse for buildings. (Abdul-Jabbar -2022), (Alhojaly & others-2022), (2022 - Erdogan), (Erdogan -2021), (A.Ragheb - 2021), and (Çakır -2020) showcased the significance of adaptive reuse to enable historical and heritage buildings to adapt to temporal changes. These studies discussed the environmental, economic, and social aspects of adaptive reuse, referring to international and local data and conventions that emphasized the concept. Some studies stressed the effectiveness of adaptive reuse as a strategy applicable in the technological and technical evolution, investing it toward local and contemporary architectural products that are acceptable and legitimate to meet societal requirements. Additionally, these studies delved into the factors influencing adaptive reuse, defining effective and influential criteria to change opposing perspectives.

2. Methodology of the study

From observation and analysis of previous studies in their various approaches, it appears that they addressed the importance of the concepts of addition and expansion on one hand, and adaptive reuse as another concept separately, without linking them. Additionally, some studies were limited to a specific geographic location or a single function only, lacking comprehensiveness in addressing the subject. Despite the abundance of studies that covered global experiences, there is a scarcity in addressing local experiences. Therefore, the research problem emerged as the "lack of knowledge and local studies and applications regarding the adaptive reuse of historical and heritage buildings through expansion and addition processes of all types used in them, and the need to reassess these experiences compared to successful global experiences, and the extent to which they meet the needs of their occupants." The research assumes the following: "The importance of reevaluating the experiences of adaptive reuse globally that have practically achieved the concepts of addition and expansion on one hand, and selecting successful strategies in the process of future addition and expansion for local buildings that require addition and expansion to adapt to new requirements and the spirit of the time.

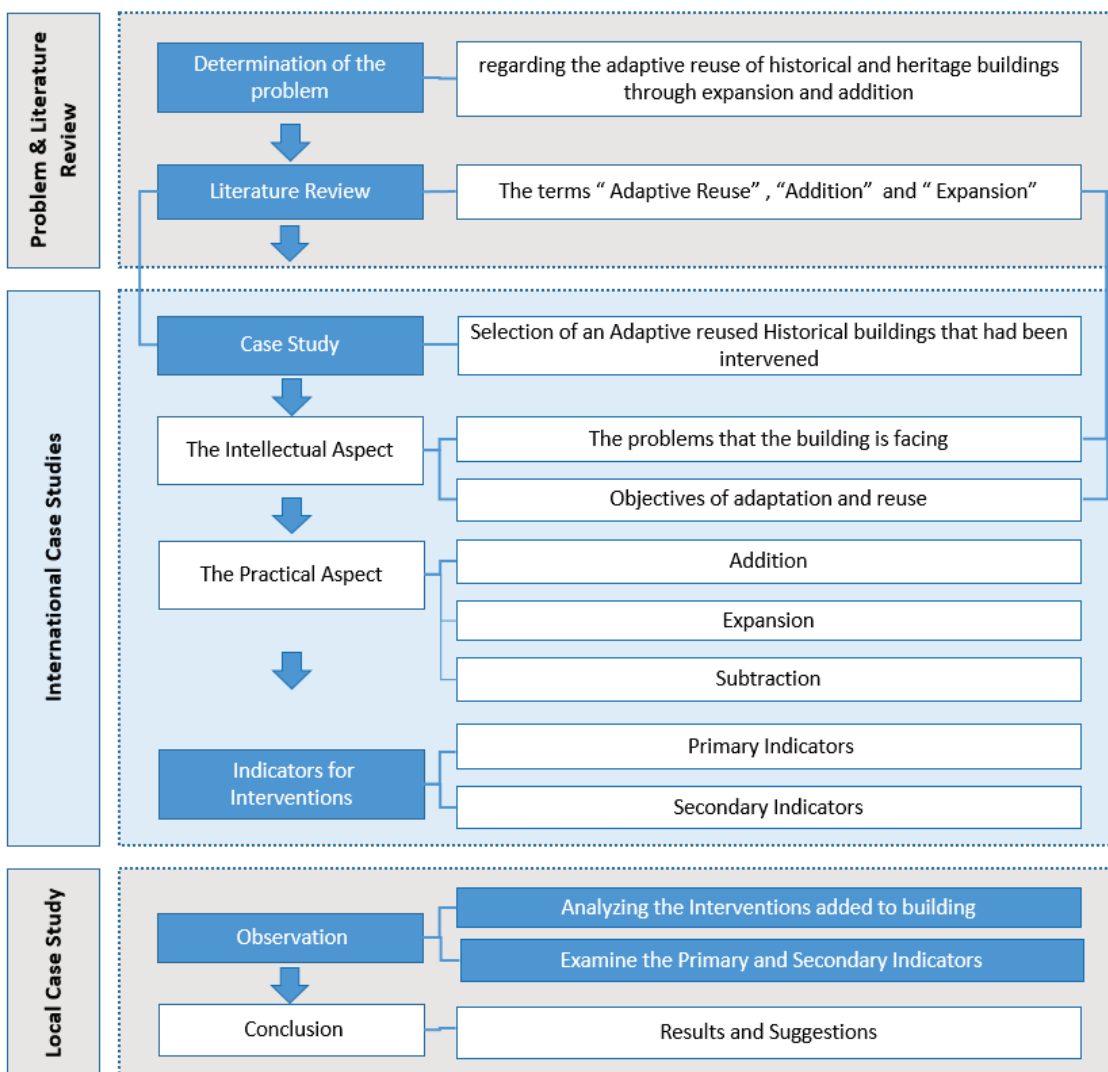


Fig. 1. Methodology of the study

3. Conception of building lifespan, adaptation, addition, and expansion

There is a need to address the key concepts and terms related to the research and delve into their definitions linguistically and technically. Subsequently, procedural definitions are crucial as an important entry point for understanding the boundaries and the subject of the research. These concepts include (Building Lifespan, Adaptation, Addition, and Expansion).

3.1 Building Lifespan

Architecture began as a response to various needs, evolving and changing over time with the development of civilizations and societies. Due to its enduring nature, buildings usually outlast other entities. However, buildings need to adapt and align with the evolving needs of users. It's observed that a building may reach a stage requiring modification, addition, or functional changes to accommodate the surrounding developments. These interventions depend on the nature of the building, primarily related to what is known as the building's "lifespan," which is one of the reasons leading to its reuse and adaptation.

The concept of building lifespan is commonly introduced in studies to express the period during which a building is used until it reaches a certain stage where it struggles to achieve optimal use. A building might undergo significant adaptation or reach the end of its lifespan, often resulting in demolition. The life of a building is often seen as a cycle that involves operations, usage, and adaptation. Studies addressing the concept of building lifespan and the method of determining the duration after which the building needs functional, spatial, or structural interventions after the end of its assumed lifespan have varied. These studies consider factors such as location, building structure, building envelope, services, interior design, furniture, and users. The lifespan of a building is typically associated with the assumption that the building site is permanent. The building structure usually lasts from 30 to 300 years, the building envelope for 20 years or more, services for 7-20 years, interior design elements for 3-30 years, and furniture for around three years. (Brand, 1994 p.13) (Douglas , 2006, P.12)

Other studies have divided the levels themselves in determining the building's lifespan but with different estimates. For instance, the expected lifespan for interior finishes ranges from 5 to 10 years, services from 15 to 20 years, building function for 30 years, and the building structure for 50 years or more. (Condello & Lehmann, 2016, p. 56) Some studies have further divided the building into primary and secondary structures, each with a specific lifespan. The primary structure and building envelope typically last from 50 to 100 years, while the secondary structure (including walls, non-load-bearing floors, lighting systems, and communication systems) lasts from 15 to 50 years. Fixtures, furniture, and furnishings typically last for 5-15 years. (Cowee & Schwehr, 2012, p.17) The concept of building lifespan is associated with other related concepts such as technical lifespan, economic lifespan, and functional lifespan.

3.2 Adaptation

In language dictionaries, "Adapt" is described as a counterpart to the concept of adaptation. It is derived from the Latin word "adaptare," which combines "ad" (to) and "aptare" (fit). The term signifies adjusting something and making it suitable for new needs or conditions. Therefore, "Adapt" in English is defined as:

1. to make or become suitable for new needs or different conditions (Longman, 1992, p.12).
2. become adjusted to new conditions (Oxford dictionary, 2010, p.9).

In the field of architecture, the concept of adaptation refers to the interventions that occur in a building, often involving changes in its function or performance to make it suitable for new conditions and requirements. The term "adaptation" has been commonly used to describe improvement actions, such as adapting buildings for use by people with special needs or the elderly. Douglas, however, provides a broader definition, indicating that adaptation includes any action on a building that goes beyond maintenance, involving changes to its capacity, function, or performance. According to (Douglas, 2006, p.1), adaptation involves interventions to modify, reuse, or upgrade a building to suit new conditions or requirements.

Studies differ in their explanations of the concept of reuse. Some researchers, like (stone, 2019, p.4), argue that reuse and adaptive reuse essentially have the same meaning, focusing primarily on changing the building's function. They describe it as the process of changing the function of a building that has become outdated to accommodate a new purpose. Others, like (Plevoets & Van Cleempoel 2019 ,P.23), state that adaptive reuse refers to changes involving both the physical and functional levels of the building, regardless of the degree of change. It includes modifications that affect both functional and material components. The degree of adaptation can vary from significant changes to almost complete structural and aesthetic alterations to minor modifications in the interior. Some emphasize the importance, especially in reuse projects, of preserving the non-material values associated with the building, such as social, religious, or commemorative significance (fiorani & others, 2017 ,p.1). Therefore, adaptive reuse or adaptive reuse of buildings can be defined as the process of making actual changes inside or outside a building, regardless of their magnitude (whether radical or minor). The importance lies in the changes primarily occurring at the functional level. Preserving the non-material and material values of buildings, especially those with historical or social significance, becomes crucial in adaptive reuse projects. Various strategies for adaptation exist, differing in the nature and scale of interventions depending on the building's requirements.

3.3 Addition & Expansion

In English dictionaries, the verb "add" is defined as placing something next to another for the purpose of increasing its number, size, or importance. The term "addition," derived from the Latin word "addere," meaning "to add," describes the action of adding and often refers to numerical addition. In American English, "addition" also refers to a room or part of a building that has been added to the existing main structure (Oxford dictionary,

2010, p.10). In this context, it denotes an extension or annex that is attached to the primary building (Longman, 1992, p.12).

1- join to or put with something else, 2- put together (two or more numbers or amounts) to find their total value – ORIGIN Latin addere(Oxford dictionary, 2010, p.10).

3- the act of adding , 4-AmE a room or part of a building which is added to the main building. (Longman, 1992, p.12)

Therefore, the linguistic definitions suggest that the process of addition is an action aimed at distinguishing two parts (the original part and the added part), where the existence of one necessitates the presence of the other. These parts are connected for a specific purpose, ultimately creating a new product with unique specifications. In the context of architecture, addition is associated with both its intellectual and material dimensions. Architecture is not only a tangible product but also a visible manifestation of human thought. In this realm, designers express their ideas, harnessing their skills and capabilities to generate a product that aligns more with existing or emerging needs or for the purpose of introducing variety. (Al-Jadraj, 1995, p. 209) On the material aspect of addition, Byard defines the addition as the process of creating what can be called composite works. This involves adding new structures to existing architecture to meet the need for change and create a new shared identity that expresses new meanings (Byard, 1998, p.14). The term "intervention" has been used to describe the addition strategy in traditional cities concerning the relationship between the new added interventions and the existing architecture. It represents a phenomenon of change and its relation to the cultural values attributed to both historical architecture and the new introduced elements. (Rubio, 1985, p.232) The concept of expanding historical buildings is defined as adding a new physical entity to an old one, carrying historical value through a cognitive and physical connection that can be either contradictory or similar. This integration constitutes an expressive and functional complement within a specific temporal framework, maintaining authenticity through the processes of renewal and creativity (Moussesan, 2001, p. 94). Another definition considers addition to buildings as a design strategy specifically aimed at adding something new to something existing, following certain formats and within a defined framework regarding form and content issues. Three aspects of the addition process are outlined: the existing physical entity before addition, the added element, and the method of connecting and assembling the two ends (Al Jameel, 2004, p.83). Addition is also defined as the process of bringing a building back into use through addition and modification of architectural components and elements, with the addition of new parts, achieving efficient use of the building with the same previous function or creating a new function while preserving the essential features and landmarks that have historical, architectural, and cultural values, thus achieving harmony between the building and the requirements of the era (Al-Fayadh, 2012, p.14). The extent of intervention in buildings varies according to different factors and ranges from simple operations like wall painting to major modifications, such as adding structural elements (Douglas, 2006, p.4).

We observe from the above that the concept of addition to buildings refers to the process of introducing a change to the structure by adding a new physical entity to the existing building, based on a specific need. This change aims to enhance the previous function or introduce a new function to the building. It can take a form that is either contradictory or consistent, both intellectually and materially, with the original building. The goal is to achieve integration between the original and added entities within a specified temporal dimension. The scale of interventions varies, ranging from simple additions like replacing windows and doors to significant additions, such as adding a new building. Therefore, addition does not necessarily imply expanding the building, but both concepts serve as means of adaptation.

In English, the term "Expansion" refers to a similar process of growth or extension (Oxford dictionary, 2010, p. 313). It also describes the added thing as an expansion (Longman, 1992, p. 446). The term "Extension" is also mentioned, where "Extend" as a verb means to enlarge the area, occupy a specific space, or continue for a certain distance. "Extension" refers to the act of expanding and can also denote a part added to a building to make it larger (Oxford dictionary, 2010, p. 316). Additionally, according to Longman's dictionary, the verb "extend" indicates the expansion of space, time, or floor area.

1- the act or process of expanding or being expanded , 2- something which has been expanded . (Longman, 1992, p.446) 3- the action of becoming bigger or the state of being bigger than before . (Oxford dictionary, 2010, p.257)

Therefore, linguistically, the concept of "expansion" describes the process of increasing or adding space to something within any dimension, with the main goal of continuity for something. As a term in architecture, "expansion" is referred to as the addition made to a building to increase its area. It is mentioned as "an increase in the capacity or size of the building, either vertically to increase height, depth, or horizontally by expanding the horizontal space" (Watson, 2009, p. 218).The concept of expansion is further described as a physical activity involving the addition of spaces and perhaps a change in functions. Expansion can be functional or an increase in the number of occupants, requiring new construction either vertically or horizontally, above or below ground, and may involve changes to the facade (Al-Fayadh, 2012, p. 37). Studies have also pointed out that expansion involves

extending the floor area of a building or adding a separate building attached to the original structure (Koo & Others, 2020, p. 14).

Therefore, the concept of expansion in buildings refers to operations that increase the capacity of the building by adding a structure to it. This addition can be either horizontal or vertical, connected to the original building or separate from it.

4. International Case Studies

For a better understanding of addition and expansion and their role in the adaptive reuse process of historical and heritage buildings, it was essential to study a set of successful global examples that have succeeded in achieving better adaptive reuse for buildings. This is to derive indicators and conclusions that can be utilized in local studies. These examples include:

4.1 Coal Drops Yard

The building is located in the city of London, United Kingdom, and was redesigned by Heatherwick Studio, in 2018. The original structures were built between the 1850s and 1860s and were initially used as facilities for storing and distributing coal to various areas in London. As the coal production declined, the buildings transitioned to serving light industries and storage. By the late 1990s, the buildings were in a state of neglect (Heatherwick, 2022).

The building's function was transformed into a retail area, involving interventions such as expanding the roof surfaces of the buildings and connecting them with a new additional floor. These rooftop surfaces rise to intersect above the central public courtyard, reaching a height of 20 meters, linking the buildings together and adding an upper floor, emphasizing the centrality of the structure. This design provides a known floor area sufficient to host musical concerts or events, with 55 diverse units in size (Castro, 2018). The units include commercial spaces and other functions like cafes and restaurants, preserving the historical finishing of the Victorian industrial buildings while creating 100 square feet of new retail space and a large public area accommodating various established and emerging brands, along with new restaurants, bars, and cafes (Archello, n.d.). The study also considered the original structure and its capacity to accommodate additional floors. It was found that the old structure had limited capacity for additional loads, so a new independent upper-level structure and roof were created, supported by steel and concrete frames, linked through the original buildings and anchored on new small columns enclosed within the gaps between the inner walls (Heath, 2020, p.12).

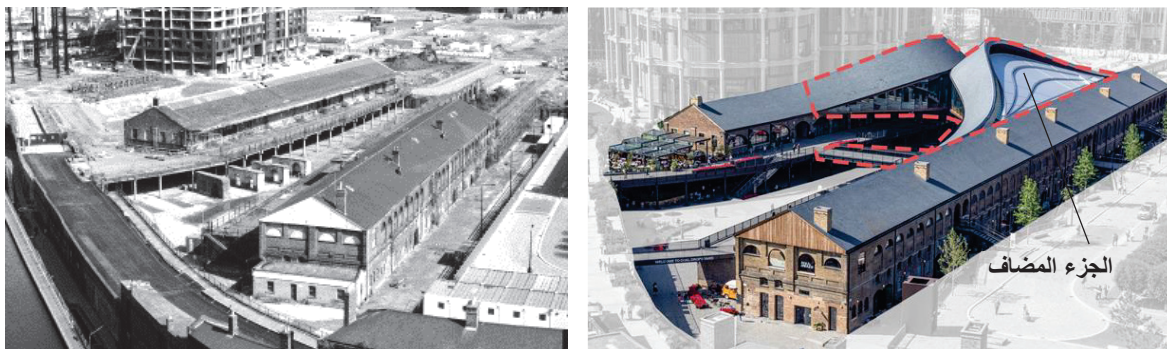


Fig. 2. Coal Drops Yard Before & after adaptive reuse
Source : (Heatherwick, 2022)

4.2 SESC Pompeia

The sports center is located in the city of São Paulo, Brazil, and the main building was designed as a barrel factory. Between 1962 and 1963, the function of the building was converted into a refrigerator factory until 1967. Afterward, the building was left neglected, except for occasional use by neighbors during weekends (de Almeida, 2015, p. 5). Recognizing the importance of preserving the lively activity that had emerged among the locals and enhancing it, SESC (Social Service of Commerce) commissioned architect Lina Bo Bardi to develop the complex and transform it into a cultural center that was completed in 1986 (Ferraz, 2012; Archeyes, 2022).

To ensure the preservation of the old structures, the designer proposed that the addition be separate from the original building while maintaining a connection between the new and old structures. Three reinforced concrete

towers were added next to the old halls of the barrel factory: one with a rectangular layout, reaching a height of 45 meters housing sports courts, a second, smaller but taller rectangular tower measuring 52 meters, containing changing rooms and exercise rooms, and a third cylindrical water tower with a diameter of 8 meters and a height of 70 meters (Fracalossi, 2013). These towers are connected by eight pre-stressed concrete walkways in the shapes of the letters Y and V, with lengths up to 25 meters, responding to the site's conditions, including the presence of an underground water channel (Ferraz, 2012).

Regarding the spaces within the old factory, functions were transformed with limited additions. The designer suggested restoring the current building to its essence, highlighting the reinforced concrete structure and brick walls, preserving many details of the old factory visible in walls and floors. This approach significantly enhanced the sense of place from a social perspective (Condello & Lehmann, 2016, p. 59). The new use incorporated various social activities, with the building housing a theater, library, exhibition space, playgrounds for children, and dining areas.

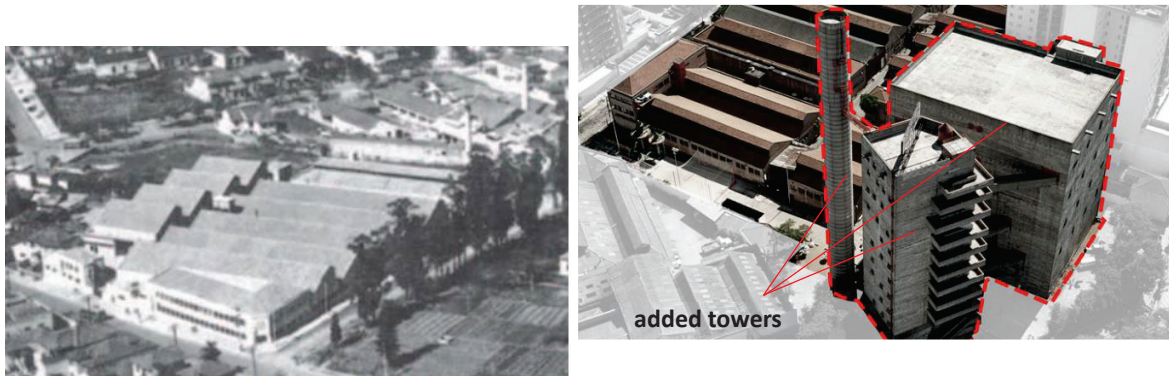


Fig. 3. The three added towers and their relationship with the old building.
Source: (Archeys, 2022)

4.3 the Museum of Contemporary Art Zeitz Mocaa

The building is located in Cape Town, South Africa, and was constructed in the 1920s (Press, 2017). Originally built as a grain silo during the era of racial segregation, it served as a means to provide employment opportunities for poor white individuals. The silo complex reflects the deeply divided social landscape of Cape Town during the apartheid era (Burger, 2016). After operating as a grain storage facility for years, the need for the silo diminished with containerized shipping. Eventually, the neglected building was repurposed and transformed into a museum by German businessman and art collector Jochen Zeitz in 2017. The museum, designed by Thomas Heatherwick's studio . (Sainani, 2022, p. 26).

The original structure consists of two connected buildings, with the first being a series of cylindrical grain storage silos (42 in total) made of reinforced concrete, and the second being a tower used to lift grains to the storage area. During the adaptive reuse process, most of the concrete structure was retained. A central atrium, created by cutting into the silos, became the museum's entrance, with suspended floors added for exhibition spaces and other activities. The exhibitions were designed by cutting the surrounding silos and adding suspended floors (Koslu, 2022, p. 201).

The architectural intervention included cutting large portions of the surrounding silos to create five floors of exhibition spaces for permanent and temporary exhibits. The carved high cylinders above the central atrium allow daylight to enter through layers of patterned laminated glass, providing a walking surface to the sculpture garden on the upper floor. The concrete walls in the settlement tower were cut to create new three-dimensional windows (Heatherwick Studio, n.d.).

The original concrete of the silos was carefully treated before cutting, using structural concrete sleeves, and then manually cut with a combination of electric cutting machines and diamond-studded wire saws (Beaumont, 2017).

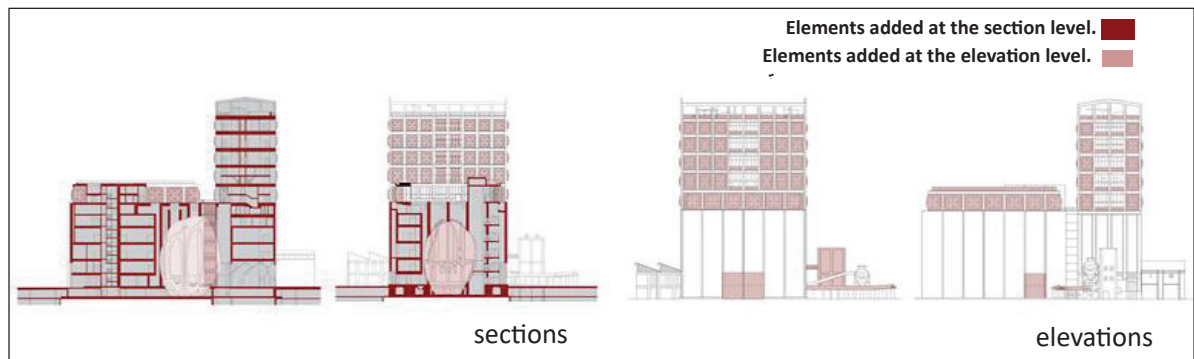


Fig. 4. The modernized parts in the Zeitz Museum of Contemporary Art Africa (Zeitz MOCAA). Source: The researcher with modifications from (archello, n.d)

4.4 Quarry Theatre at St Luke's

The building is located in Bedford, United Kingdom, The church, initially located on St. Peter Street in Bedford, was founded in 1751, but a decline in the number of worshippers led to its closure in 2008. The building was then sold to Bedford Modern School and repurposed into a theater named "The Quarry Theatre," officially opened in 2015 (bedsarchives, n.d). The historic building, along with the former Minister's House adjacent to it, was utilized to create a center for performing arts. The church was transformed into a theater, and "The Quarry Theatre" designed by Foster Wilson Architects and was established by utilizing surplus parts from the Moravian Church and the Minister's House. The building serves as a new arts center for Bedford School and the local community, emphasizing the connection between the school and the community (architizer, n.d).

The interventions included the introduction of a structure for an exhibition space within the original church, adding a new lobby that wraps around the semi-circular wall of the church. The church was converted into a flexible 300-seat courtyard theater, and the Minister's House was renovated to provide front-of-house facilities, offices, and studios, with a new lobby and an extension behind the scenes. The new lobby wraps around the semi-circular wall to the original altar, offering curved glass walls with views of the secluded gardens in the old church courtyard. The theater itself is a flexible flat-floored space, created by introducing a new steel structure inside the current church volume, allowing the existing interior to be readapted. The existing balcony was rearranged, and two levels of new exhibition spaces were introduced on the sides, along with high-level hanging systems for landscapes and stage lighting (architizer, n.d).

To preserve the historic character of the building as much as possible, original finishing materials were highlighted and damaged ones were repaired similarly. Lime plaster was used throughout the original buildings, and the original exterior brick of the altar was left exposed in the new lobby, complemented by fair-faced brick in the new work. New oak flooring and carpentry were used to unify the old and new throughout the project (archello, n.d).

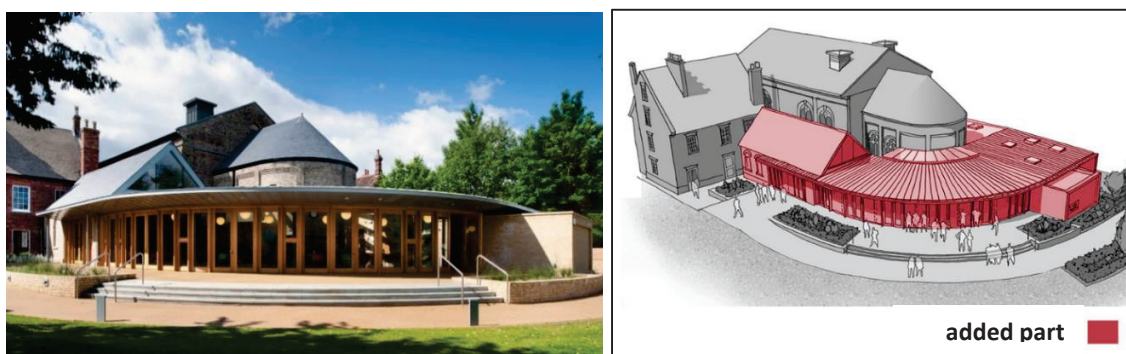


Fig. 5. The new form of the Quarry Theatre building after the addition. Source: The researcher with modifications from (architizer, n.d).

4.5 Kaufhaus Breuer

The building is located in Eschweiler, Germany. The original store built between 1946 and 1951 originally consisted of a four-story reinforced concrete structure. Despite the ground floor continuing its use as retail space in a well-known commercial area in the heart of Eschweiler, the upper floors, designed for open-plan sales, were neglected for over 30 years due to continuous changes in the retail sector, leading to vacant spaces (competitionline, 2023; Kaiser, 2007, p.141). In 2005, BeL Sozietät für Architektur developed a conversion concept in collaboration with clients, and the execution was completed in 2006. The building's new usage was planned to be multi-functional, combining commercial and residential purposes. The ground floor retained its commercial use, while office space was created on the first floor. The second and third floors were converted into barrier-free service apartments for seniors, featuring a shared rooftop terrace accessible by a modernized elevator. The exterior façade of the building, characterized by Erich Mendelsohn's design language, was preserved, considering it a "prominent architectural landmark" in the city center and reflecting the modernist style of the 1950s (Steckeweh & others, 2009, p.21).

Several interventions were made to achieve the new use. Staircases were added along the rear wall, with cutouts in the upper floorings to provide access. Atriums were also added, penetrating one or two floors to provide ventilation and natural light to the apartments, doubling as outdoor areas for the residences. The second floor accommodates six apartments, five of which open onto a shared living area of 80 m². Four of these are one-bedroom apartments, one is a two-bedroom apartment, and the sixth apartment is wheelchair-accessible. The third floor contains four additional apartments ranging in size from 52 to 70 m², designed for seniors (Kaiser & others, 2007, p.141-145). The site's infrastructure, with nearby shopping, dining, and medical facilities, along with easy access to bus and train lines, has helped attract seniors who seek to continue living independently for as long as possible (Kaiser & others, 2007, p.145).

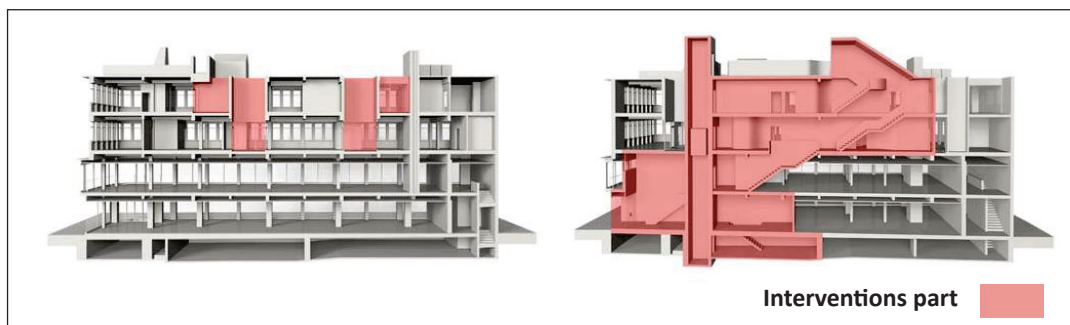


Fig. 6. Interventions on the department store Kaufhaus Breuer.

Source: (competitionline, 2023).

5. Results and Discussion

After discussing a set of global experiments, the cognitive aspects provided by these experiments in the field of describing the intervention processes for reuse will be examined. To facilitate understanding of the interventions and their relationship to the need for adaptation, they will be discussed in two aspects: the intellectual aspect related to the origin of the need for adaptation. It includes key indicators representing the main problems faced by buildings and the goals that led to the decision to adapt and reuse. And the practical aspect, which consists of the interventions and their physical formation.

5.1 Analysis of indicators of adaptive reuse for historical and heritage buildings

There is a certain diversity in the problems faced by global buildings that prompted the need for adaptation and reuse. The secondary indicators and their implications resulting from the analysis of the aforementioned global examples can be summarized in the table below:"

Table 1. Primary and Secondary Indicators for Interventions related to the Intellectual Aspect

Primary Indicators	Secondary Indicators		References	
The problems that the building is facing	obsolescence	Functional	Complete lack of need for the building's function	(Grecchi ,2022, p.4) (Butt & Others 2015,)
			Partial lack of need for a portion of the building's function	
		Physical	Structural damage to the building	(Grecchi ,2022, p.4)
			Damage to a part of the building	
	Economic	Economic viability decline	Iselin ,1993, p.20) (& Lemer	
	Social and Cultural	Change in societal needs and cultures	(Grecchi ,2022, p.4)	
	Increase in the number of users	Growing cultural, religious, or commercial significance for publicly used buildings.		(Watson ,2009, p.218) Koo &) (Others,2020,p.14
		Expansion of the building's operations for .privately used buildings		
	Inefficient utilization	Mass	The structure's capacity to bear additional weights	Douglas , 2006, P.31) (
			Space distribution	
Site		The available site spaces are not utilized		
		Increased importance of the site surrounding		
Objectives of adaptation and reuse	Preservation	The heritage and historical value		,2014, p.22) (Wilkinson
		The societal value		
		The architectural value		
	Economic value	Improving the building and thereby increasing its economic value		(Bullen, 2007 , P.29)
		Saving costs of demolition and reconstruction		
	Environmental sustainability	Preserving resources and materials		Douglas , 2006, (P.462 ,,2014, p.28) (Wilkinson
		Reducing environmental damage		
	Enhancing efficiency	Using modern systems and technology		(Bullen, 2007 , P.29) Kincaid,2003,) (P.27
		Improving environmental efficiency		
		Making design modifications to meet evolving requirements		

□ The Practical Aspect

There is clear diversity in dealing with global buildings in terms of adaptation and reuse, and intervention strategies can be categorized into: Addition, Expansion, and Deletion. It is also observed that these strategies are sometimes implemented individually or in combination in some cases. The secondary indicators and implications resulting from the analysis of the aforementioned global examples can be summarized in the table below.

Table 2. Primary and Secondary Indicators for Interventions related to the Practical Aspect

Primary Indicators	Secondary Indicators		References	
Addition	Small	Renewing finishes	(Douglas , 2006, P.4)	
		Adding adjustable elements (doors, windows, etc.)		
	Medium	Adding small spaces		
		Adding means of movement		
	Large	Adding new buildings		
Adding new floors				
Expansion	Horizontal	The available land on the site	Space availability	(Byard , 1998, P.151) (Cowee & Schwehr ,) (2012, P.34
		Access to the added part	Usability	
		Functional relationship of the added part with the building	Need for quick access	
			Not necessary	
		Continuous	Separate	
			Separate	
	Vertical	Durability of the existing structure	Addable	(Byard , 1998, P.151) (Cowee & Schwehr ,) (2012, P.34
			Not addable	
		Mass form	Continuable	
			Not continuable	
	Internal	Durability of the existing structure	Addable	Dibner & ,1985, P.15) (Dibner
			Not addable	
		Dimensions of spaces	Space area	
			Space height	
	Around the building	Surrounding land	Space availability	Dibner & ,1985, P.15) (Dibner
Usability				
Flexibility of the existing structure		Extendable		
		Not extendable		
Subtraction	Horizontal	Walls	(Douglas , 2006, P.8)	
		Partitions		
		Spaces		
	Vertical	Floors		
		Movement elements		

5.2 Validation of the redesign according to the indicator method using a local case study: Baghdad Qishla Building

□ Historical Overview

In 1831, central rule returned to Baghdad after the fall of the Mamluks. At that time, there was serious consideration of constructing buildings, some with a civilian character and others with a military one. Among them was the Qishla, which was erected next to the Saray (Palace) as part of a complex housing all the departments related to the military institution in Baghdad. Today, it is located near Mutanabi Street in central Baghdad, overlooking the eastern banks of the Tigris River. Most of the Saray buildings, including the Qishla, were built during the reign of Wali Namik Pasha the Great, specifically during his first term in Baghdad, which lasted for about two years (1851-1852 AD). He held military and administrative positions, serving as the marshal of the Iraq and Hejaz army and later becoming the governor of Baghdad (Al-Azzawi, 1955, p. 89). Namik Pasha built the Qishla with one floor to accommodate thousands of infantry soldiers during the winter. Later, during the governorship of Muddhat Pasha (1869-1872 AD), who completed the construction, the upper floor was added. Muddhat Pasha demolished the eastern wall of Baghdad to fund the construction. He also installed a clock in the middle of its courtyard to wake up the soldiers; it was carried on a tall tower (Al-Azzi, 1978, p. 232).

The Saray complex, including the Qishla, was visited by the contemporary traveler William Fucco in 1874. He described the Qishla as a huge building adjacent to the Saray on the banks of the Tigris, with a structure that housed thousands of soldiers (Fucco, 1960, p. 24).

After the British occupation in 1917, the Qishla was used as a residence for British officers and their families. The square in front of the Qishla witnessed the coronation of King Faisal I of Iraq on August 23, 1921 (Al-Tarfie, 2013). Subsequently, the Qishla served various government functions simultaneously. It became the headquarters for the Ministry of Finance, the Directorate of Public Works, the Directorate of Post and Telegraph, and the Council of Ministers. In the 1970s, it was occupied by the Judicial Institute and the Presidency of the Legal Documentation Department (Al-Hadithi, 1978, p. 84). In 1991, a decision was made to use the Qishla building as a museum, collecting documents related to the reconstruction efforts after the 1991 Gulf War. Currently, the Qishla and Saray doors are open to tourists and citizens for cultural and recreational purposes, especially on Fridays. It has become a platform for citizens to express their opinions and requirements. This path has a strong existential force, imposing itself and attracting those around it, considering its historical significance and the presence of several heritage buildings (Al-Tarfie, 2013).

□ Interventions and Adaptive Reuse

The new expansion for the purpose of reuse included the construction of a new floor above the single-story building with the same ground floor system consisting of a corridor opening onto a series of rooms. It is natural for the corridor on the ground floor to differ from that on the upper floor because they are not synchronized in history. The ground floor is covered with a series of cellars facing the courtyard in a perpendicular manner, separated by semi-circular arches. The corridor on both floors overlooks the courtyard with low arches. As for the upper corridor, which advances the halls, it overlooks the courtyard with arches resting on shoulders, as in the ground floor. The ceiling was originally level with wooden beams extending in cylindrical beams topped with a layer of reeds and mud. The ceiling was renewed after being damaged due to neglect, aging, rainwater leakage, and the spread of termites and was replaced with iron (Shilman) and bricks." (Al-Daraji, 2018, p. 25).

"The addition also included the construction of the clock tower, a tower located in the middle of the courtyard and overlooking the river, built with bricks and gypsum, with a height of 23 meters (Al-Azzi, 1978, p. 232). It consists of three layers, with the first layer representing the base, including an entrance topped with a knot leading to a wooden staircase arranged in a spiral that stops after reaching the clock. Above the base rises a square body with rectangular light openings distributed geometrically on three regular groups. The body is topped with a protrusion supported by cables, followed by a square neck carrying a clock on each of its four faces, with chimes audible from a distance, erected in 1869." (Al-Daraji, 2018, p. 26).

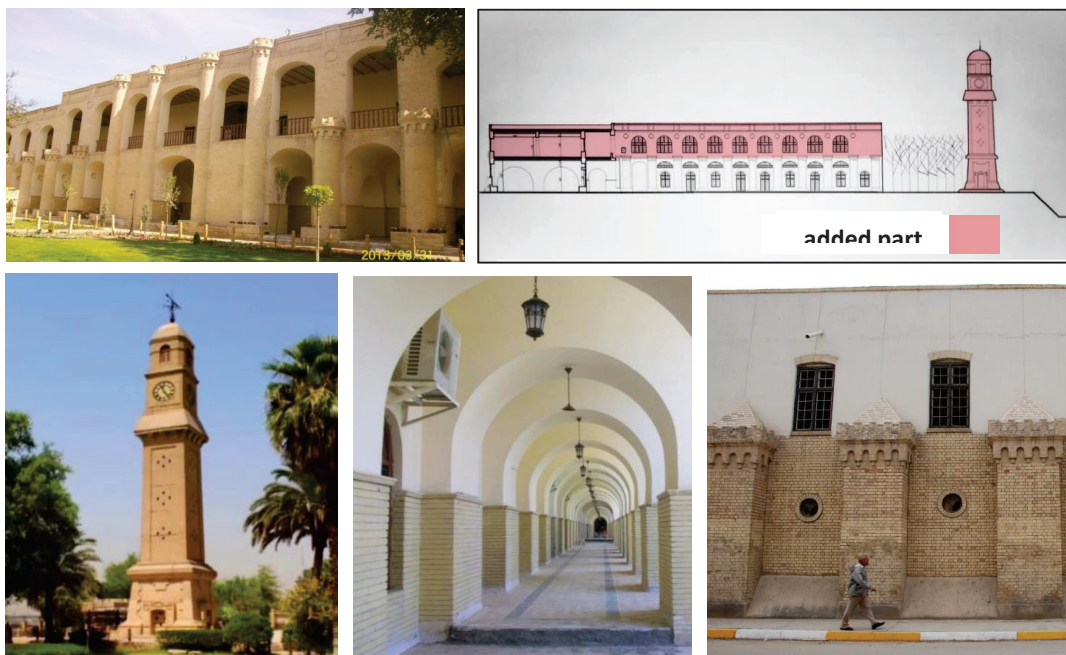


Fig. 7. The Qishla building in Baghdad and the newly added elements.
 Source: (Al-Draii, 2018). modified by the researcher

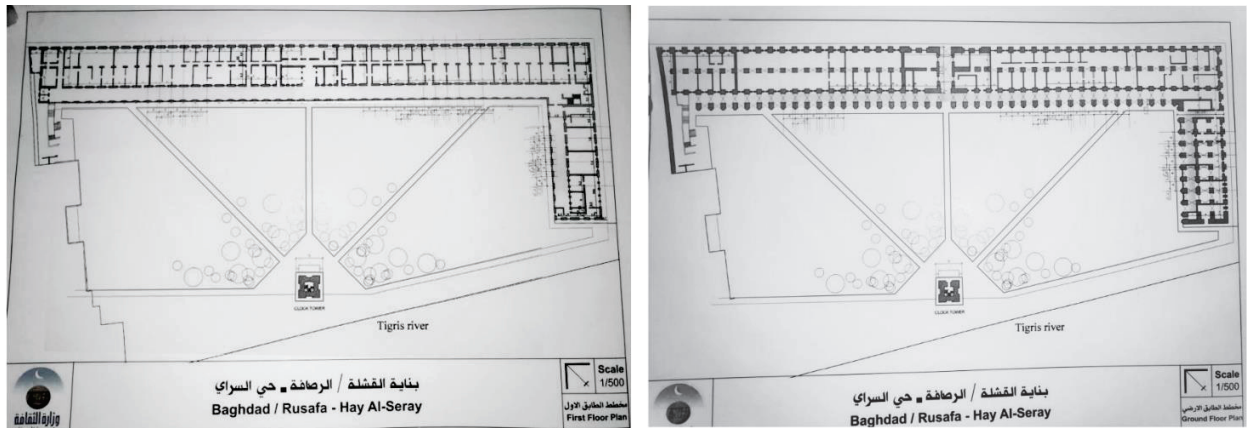


Fig. 8. Floor plan of the Qishla building in Baghdad.
 Source: (Al-Draji, 2018), modified by the researcher

Table 3. Analyzing the intellectual aspect of the interventions related to the Qishla building in Baghdad

Primary Indicators	Secondary Indicators			
The problems that the building is facing	obsolescence	Functional	Complete lack of need for the building's function	✓
			Partial lack of need for a portion of the building's function	
		Physical	Structural damage to the building	
			Damage to a part of the building	✓
	Increase in the number of users	Growing cultural, religious, or commercial significance for publicly used buildings.		
		Expansion of the building's operations for privately used buildings		✓
	Inefficient utilization	Mass	The structure's capacity to bear additional weights	✓
			Space distribution	
		Site	The available site spaces are not utilized	✓
			Increased importance of the site surrounding	
Objectives of adaptation and reuse	Preservation	The heritage and historical value		✓
		The societal value		✓
		The architectural value ¹		✓
	Economic value	Improving the building and thereby increasing its economic value		✓
		Saving costs of demolition and reconstruction		✓
	Environmental sustainability	Preserving resources and materials ¹		✓
		Reducing environmental damage		✓
	Enhancing efficiency	Using modern systems and technology		
		Improving environmental efficiency		✓
		Making design modifications to meet evolving requirements		✓

Table 4. Analyzing the intellectual aspect of the interventions related to the Qishla building in Baghdad

Primary Indicators	Secondary Indicators			
Addition	Small	Renewing finishes	✓	
		Adding adjustable elements (doors, windows, etc.)	✓	
	Medium	Adding small spaces		
		Adding means of movement	✓	
	Large	Adding new buildings	✓	
		Adding new floors	✓	
Expansion	Horizontal	The available land on the site	Space availability	✓
			Usability	✓
		Access to the added part	Need for quick access	
			Not necessary	✓
		Functional relationship of the added part with the building	Continuous	✓
			Separate	
	Vertical	Durability of the existing structure	Addable	✓
			Not addable	
		Mass form	Continuable	✓
			Not continuable	

6. Conclusions

- Each building has an assumed lifespan (technically, functionally, and economically) that necessitates adaptive reuse through horizontal and vertical expansion, whether at the structural or spatial level, above, inside, or adjacent to the building.
- With the emergence of the need for adaptive reuse of a building, the importance of precision in choosing the appropriate strategy for each building becomes apparent. This choice should be based on its function, chronological age, significance in the community's memory and mental image, available space inside and around it. The absence of an accurate and correct vision for the suitable strategy for expansion and addition can contribute to the premature end of the building's lifespan and its inability to accommodate the occurring changes.
- Through studying successful global experiences that utilized expansion and addition concepts for adaptive building reuse, it becomes evident that there is diversity in these concepts, mainly represented by horizontal and vertical expansion and addition. Additionally, expansion and addition can occur within the building's spaces and surroundings, utilizing the structural capacity of the building for vertical addition without requiring extensive spaces. Thus, a set of indicators was derived regarding the reasons for the adaptive reuse and methods of these additions.
- These indicators were applied to a local historical building in Baghdad, the Qishla building. According to the research results, the originally military barracks, later expanded, serves as a successful example of adaptive reuse. The building retained as many original components as possible, utilizing existing resources and incorporating various additions (small, medium, and large, both horizontal and vertical expansion) that suited the building's needs and constraints in dealing with mass and available land. The interventions were somewhat harmonious with the original building in terms of materials used, space planning, and architectural style. The building underwent long periods of style changes and interventions, highlighting the importance of choosing appropriate strategies for the success of adaptive reuse, supported by a deep understanding of the building's nature, historical value, and events that took place within it. The significance and societal status of the building are crucial considerations.
- The research paper provides a model that can be utilized and applied to analyze additions and expansions to reused buildings. It offers insights for architects and decision-makers in designing suitable additions and expansions for heritage and historical buildings intended for reuse, especially in the local Iraqi context.

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