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Research Article:

The Impact of Exterior Additions on Cohesive Design Relationships: Heritage Buildings of Sulaimani City as a Case Study

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Abstract

The addition is one of the important concepts that accompanied the history of human civilizations since ancient times. It represents a civilized product that embodies human cognition as well as social and utilitarian demands throughout history. Designing for the historic context inherently brings challenges and necessitates a comprehensive understanding and sympathetic analysis of all aspects of the existing structure or buildings. A comprehensive understanding of the nature of heritage structures, as well as conservation philosophy, may help guide interventions or new additions. Will result in the most efficient adaptation process, preserving the original characteristics while developing the new structure. The aim of this study is to determine the compatibility of the new addition's architectural expression in relation to the characteristics of a heritage building. This technique is based on architectural and statistical analysis, which considers the heritage character of a historical structure in relation to its values. According to the results, the nature of additions should first be clearly characterized, and each new addition should reflect the identification of its own time. Rather of changing the scale or shape of the old structure, a new addition should complement and contribute to the feeling of proportion, emotion, and historical formation.

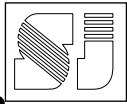
1. Introduction

Structures have been developed throughout history to facilitate human activities. These structures inevitably need to be modified, replaced, or enlarged throughout time as they grew obsolete or inappropriate for their original purpose. Many of the structures that accommodate residential, commercial, institutional, industrial, and educational functions have to expand to suit new requirements as the world's population rises and technology develops [1]. Heritage buildings define people's identities because they embody the community's memories and are a living sign of the inheritance's authenticity and deep link with inherited customs and traditions. As a result, the importance of conserving the identity of heritage and historical buildings derives from the role they play in accomplishing temporal communication by bringing the past into the present, as the research investigates this process. Because these structures are subjected to continual transformation and change, which

compromises their functionality and expressiveness, new expansions and additions are necessary to improve the present structure's functionality and expressiveness [2]. The design of building additions brings unique challenges to existing building owners and the design firms they retain. This distinguishing feature arises from the fact that this type of building must meet two sets of criteria:

1. The new functional needs that must be accommodated.
2. The current state of the "existing" building.

The approach to the design of the entire structure is determined by the balance of these two sets of requirements. The success of an adaptation process is determined by whether or not the functional and aesthetic aspects of the resulting building function well as a single combined entity [1]. Instead of damaging the heritage building's character, an effective adaptation preserves the existing structure



and its historic environment by adding a contemporary layer to it [3]. Adaptive reuse of a heritage building is a complex process since the heritage building's values, physical attributes, and potentials must all be considered holistically [4].

2. Literature Review

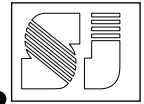
The following previous studies have been reviewed to specify the research problem statement and the research gap: The study of Torres offers specific and detailed indicators that may support the architect in the process of creating a new addition design. Focused on the formal characteristics and confirmation on how to establish a clear guideline or for adding to a historic building using a contrasting style. When considering contemporary additions to historic structures, the balanced connection between them should be prioritized rather the beauty or attractiveness of the new design. Furthermore, how to retain coherence in connections while avoiding major structural changes. By relying on the following elements: the original building or architectural context that relates to the human scale, the control of the general volumes, mass and proportions, avoiding competition between the addition and the original building; the use of compatible materials, colors and texture [5]. Torres' study offered specific and clear indicators that may support the architect in creating a new addition design. However, it is focused on the using a contrasting style, and did not take into account the levels and degrees of conversion when designing the contemporary addition. The study of Dibner, David & Dibner- Dunlap, Amy, 1985, indicated the various trends in the addition of historical and architecturally significant buildings. Ranging from the identical copies (duplication) of existing built structures to the dramatic aesthetic contradictions. Focused on the design process and thinking that went into developing solutions, and principles upon which they are based. Indicating the importance of conducting a building analysis before starting with an extension to an existing structure. Many considerations must be taken into account when making this decision, including functional, economic, emotional, legal, aesthetic, and engineering technological advancement. These factors might all be crucial in promoting the additional design of any structure in response to the development requirement [1]. Dibner's propositions referred to the role played by preservation laws in defining historical structures and encouraging them to new addition by using basic principles in the new building to harmonize with the existing building, but in a more modern style and in a way that indicates and recalls the original building's shapes without trying to replicate or create copies of it. The researcher did not address the basic principles of designing contemporary additions, which contribute to the

preservation of details and volumes, as well as the appearance of the old façade with the addition of other elements to satisfy the required functions and new needs. The study of Byard, Paul Spencer, 1998, was concerned with dealing with the old historical buildings through adding and reusing them in new contexts and functions to reflect their importance. Whose success depends on both the existing value and the added value, and the final value resulting from the interaction of each of them. In order to develop a practical framework, to help architects produce successful and meaningful combined works. On the other hand, help public individuals to understand and assimilate those works. And then to reach a rational, objective, convincing judgment about the success or failure of those actions. The study defined that combined works as “a new architecture added to an old one to meet the need for change, and to suit the growing needs, generating a new composite identity that expresses new meanings” [6]. The study was concerned with dealing with the old historical buildings through adding and reusing them in new contexts and functions to reflect their importance, but his dealing with them was on the formal level of the building, as he was interested in the expressiveness of the added forms of the building. He did not have a fixed expressive orientation as he tried, on the one hand, to deal with the building's conservative relationship by protecting the identity of the building and its styles. On the other hand, he tried to use contemporary technology and strange shapes that contradict the nature of the historic building.

The Study of Brolin focused on understanding how visual relationships were built in the past can generate appropriate decisions in the present and future. He pointed out that designing a building sympathetic to its surroundings requires creativity, skill, and the rational practice of the craft of design. It has never relied on route duplication. Brolin's study explained the role of additions in achieving homogeneous expressiveness and visual continuity in dealing with the design of the old building of different periods and styles without contradicting it except in certain cases [7]. The study focused on a specific pattern of additions that relate to the physical dimensions of connecting the old and new in height, similar materials, similar massing, by itself will guarantee a sympathetic relationship that can be made in several ways:

- Closely copying the existing design motifs.
- Using basically similar forms but rearranging them.
- Inventing new forms which have the same visual effect as the old.
- Abstracting the original forms that affect their recognizability.

According to Abel and Chris (1997), new architectural concepts emerge from the efficacy and



strength of perceiving the new in the expressiveness and language of the old. Thus the creative act does not involve much in rejecting the old ideas, but rather the familiar ideas are used in new cases and combinations by undergoing a certain kind of transformation". Emphasized that architectural identities are "built," and that they are not just dependent on coherence or a common set of values; diversity is a feature of local architecture. It plays an important role in the formation of this identity [8]. The study concludes that the relationship between the old and the new, as well as their mutual influence, can be divided into two categories: either creating something new that is unrelated to the past, or creating a creative act by linking it to old ideas through a compatible thinking. It is necessary to take into account the role of metaphor and new architectural ideas in the process of addition. In order to modify the concepts of preservation and renewal and to better understand the nature of architectural creativity.

3. Research Problem, Aim and Hypotheses

The research problem is about the levels of additions and types of relationships expressing the compatibility of the heritage buildings. The research aim is identifying the compatibility of the type of new additions and the technique used according to its effect on both building's significant characteristics and heritage character of the whole mass. The research hypothesis is the variation of the impact of main approaches of exterior additions (nature of elements, design principles, techniques of additions), on the elements and characteristic of the heritage buildings.

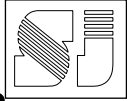
4. Methodology

For the purpose of achieving the research aims, the following methodological stages will be followed and demonstrates in Diagram 1:

Theoretical part: Building a complete theoretical framework for the concept of addition in architecture on the one hand, and the main design approaches for additions on the other. Furthermore, identifying the most relevant factors and indications that the research will take into account.

Practical part: analyze and study the experiences of exterior additions to a group of international and local heritage buildings using the theoretical part's main and secondary indicators. Depends on the architectural graphic analysis to determine the extent to which new additions' architectural expression is consistent with the characteristics of old structures. As shown in tables (1, 2, 3, 4). The method of analyzing the results of case studies depends on the analysis of the main and secondary indicators through the evaluation model (table 5), and the identification of measurement cases that are measured in the analysis

of case studies based on a statistical analysis system such as relative frequency analysis, association analysis, and singular indicator analysis, as shown in tables (6, 7, 8) and figures (1, 2, 3, 4). In mathematics, addition is defined as the sum of two or more quantities. It is a quantitative process of increasing the number or degree of something. However, in architecture, the addition of a new structure to an old building result in more than just extra space. The value of the building, its property value, its interactions within the context, and its place in the continuum of age. All alter as the size or scope of the host structure grows. Its new value is the result of the old, the new, and the various implications of its new identity [10]. Extending, adding floors, expanding, integrating, complementing, rounding off, wrapping the variety of names for the building measures that may be summed up as "addition" illustrates the vast variety of architectural possibilities instantly. Their goal is to obtain extra space, renovate a building to allow for new purposes, or even improve the aesthetic of an existing structure by erecting a new enclosure around it. The architecturally attractive old building inspires the newly added component in such circumstances, offering it visual maturity and ambiance. The coexistence of significantly divergent building stages contrasts perspective and layers of time; it provides unexpected spatial sequences, rough transitions, and other things that a completely new building cannot offer. The contrast inscribed the old and new reinforce and enrich each other [11]. Addition is defined procedurally as a design process based on a plurality in the nature of contemporary techniques, at different levels, to form an architectural product with intellectual and physical dimensions. Possesses the characteristics of creative work of authenticity, novelty and value, appropriate and distinct. Contribute to developing and creating an integrated communicative environment with the heritage structure, acting as a bridge (time interval) connecting the past, present, and future. The actions of addition are related to the factors of various transformations and changes over time. That is vary due to a variety of circumstances that impact their physical and formal structure, making them less efficient in performing their functional and expressive activities. As the main reason for requiring building additions is to improve the structure's functionality. They occur when the building's efficiency and intensity of usage evolve and increase, and this growth is an expansion in the sort of activity or function itself to fulfill the requirements of the age. The process of rehabilitating some structures of heritage value is driven by the necessity for conservation. The structural and functional state of most of these structures deteriorates with time. As a consequence of variables such as deterioration and



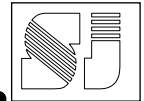
transformation, as well as cultural, social, and intellectual alterations. This sort of addition presents designers with particular challenges in balancing the demands of conservation, expansion, and economics to create a solution that matches all needs [1]. Dibner also explained that the economic factor plays a vital role in determining whether it is necessary to expand any building, or add contemporary activities in order to obtain reinvestment and achieve economic gains. Other important factors justifying decisions for additions to old buildings to revitalize them include cultural and political changes. For example, Thomas (1977) observed that a change in attitudes toward art as a field for the elite resulted in an increase in the number of visitors and donors, a case that pushed for the expansion of Brooks Memorial Art Gallery in 1955. While Byard discussed the influence of political transformation on raising interest in old buildings, restoring their works, and adding to them. Byard pointed out that the decision to return the German capital to Berlin was accompanied by the requirement to authorize the restoration of the destroyed structure, which included the addition of a new complex dome with advanced technology emanating from the original structure itself [6]. Sometimes disaster can be a factor in influencing the decision to expand. A fire or other severe calamity that destroys one part of the building may prompt the decision to rebuild the damaged portion while also expanding the structure [1]. Byard emphasized that such exchanges make use of the ruins of decaying structures that have irreplaceable because of its cultural, aesthetic, and historical significance [6]. It is clear from the above that all these factors and causes provide a clear and comprehensive intellectual vision for the addition. As the need for addition arises from reasons that may be additional in order to preserve the historical and heritage building that was exposed to natural disasters or demolished as a result of wars or political transformation and social ideas, so rehabilitation operations are involved. Or it may be an addition to expanding and adding a space that includes a heritage building as a result of the increasing efficiency of the building and the intensity of its uses to meet contemporary requirements. In terms of the issue of adding to a historic building, the positions of the world's leading conservation organizations are remarkably similar. The United Nations Educational, Scientific, and Cultural Organization (UNESCO), the International Council of Monuments and Sites (ICOMOS), and the United States National Park Service are examples of such organizations (NPS). They recognize the value and necessity of adapting heritage structures to contemporary demands for the benefit of users and the building's lifespan, as long as the original fabric is preserved. They also believe that any additions must

be appropriate with the historic structure and must maintain its historic character by employing a distinct and original style that reflects the current era and culture. These recommendations are valuable tools that should be used as a starting point for adding to a heritage structure, but they should be accompanied by more specific instructions on how to achieve the aims [5]. Weeks and Grimmer stated that there are three primary considerations to keep in mind while developing a new addition to a historic structure:

1. Conserve important historic materials and characteristics safe:
 - To protect the preservation of key materials and features, avoid building an addition on the major or other character-defining elevation.
 - Minimize the loss of heritage material such as exterior walls and interior floor plan partitions.
2. Conserve historic character:
 - Make the new addition's size, scale, massing, and proportions consistent with the historic structure to guarantee that the historic form is not extended or modified to an undesirable degree.
 - Insert the new addition on an unnoticeable side or rear façade so that the new construction does not drastically alter the original building's form and character.
 - Consider putting an infill addition or connection (i.e., connection block) back from the old building wall level so that the historical building(s) and new construction may be distinguished.
 - Set the new story further back from the roof edge to avoid significantly altering the original building's profile and proportions.
3. Preserve the historic value of the site by establishing a visible distinction between the old and new:
 - Design the new addition in such a way that provides some distinctions in terms of material, color, and details so that it does not appear to be a part of the original structure [12][13].

These guidelines are valuable tools, considered as a criteria that should be used as a starting point for adding structure to the heritage buildings. As part of the preservation process. They promote the adoption of a contemporary style. If well planned and developed, addition can be a viable option. A new addition to a historic building should be built in a way that preserves significant materials, characteristics, and form, as well as the historic character of the building, and achieves distinctiveness between the existing structure and the new addition.

Recognizing the different types of value in historic buildings is crucial for determining the type of intervention and the methods employed to deal with it. In order to identify the historic 'significance,' these qualities must be examined and then synthesized.



The values are divided into three categories: 'emotional,' 'cultural,' and 'use' values [13].

(1) Emotional values: identity, continuity, spirituality, and symbolism are all examples of emotional values.

(2) Cultural values: include, documentary, historical, archaeological, age and scarcity, aesthetic and symbolic, architectural qualities.

(3) Use values: functional, economic, social, educational, political, and ethnic values are all included. The building's historical value must be assessed and ranked in order of priority. These values are represented as criteria in the systematic identification of general priorities when determining proposed interventions, as well as the scope and nature of individual building treatment. The prioritization of values will always reflect the cultural environment of any heritage structure.

The nature of the formal elements of the addition Venturi refers to the phenotypic character of all aspects linked to formal elements in architecture. Their formal, tactile, structural and material properties. Their overall nature, at the level of the whole and the part, the locations and numbers of the elements, as well as the affiliation of the spatial and temporal elements (traditional and new elements) that affect the formation of the whole Difficult in the architecture of complexity and contradiction. Mentioning that "the architect's main task, through his arrangement of the parts, can bring to them new patterns rich in meanings within the whole, through the unconventional arrangement of the traditional elements, that familiar things become sensually new and old when seen within unfamiliar environments" [14]. The study of (Byard) and (Dibner) indicated the overall nature of the added elements (mass or space aggregate formations) or the partial nature (horizontal surfaces of the added floors), as well as referring to the addition sites (whether external or internal, at the level of horizontal or vertical plans).

The scale of additions that includes small, medium and large scales to the heritage buildings is determined by a set of adaption options as well as the extent of the proposed change to the building. They can range from simple preservation to nearly comprehensive reconstruction. Between these two extremes, are interventions such as refurbishing, rehabilitation, remodeling, renovation, retrofitting, and restoration. However, with heritage buildings, care must be taken to ensure that the level of intervention is appropriate and complies with the addition guidelines and heritage values previously mentioned in paragraph 6 of the research [15]. The possible variables and values for the paragraph about the formal nature of the added elements can be summarized as follows:

- The overall nature of the elements: It refers to the nature of the elements added to the formations in terms of:

The whole: which is defined as total mass, spatial or schematic formations ... and so on.

The part: which is defined by the various parts of the building, which includes both the vertical surfaces (facades) and horizontal surfaces (floors and ceilings), the structural structure, as well as various other parts (openings, lines, columns, partial formations such as stairs and slopes ... and so on).

-Appearance nature: which refers to the phenotypically nature of the elements in terms of being basic: shape and patterns, size, direction. Or in terms of being secondary: associated with different surface treatments of material, texture, color and light.

- Scale of interventions: with historic buildings, however, care must be taken to ensure that the level of intervention is appropriate and complies with the conservation criteria.

In this study, design principles can be categorized as unity, harmony, contrast, dominance, repetition, balance, scale, and proportion [16].

- Unity

In design, unity is connected to composition, which is generated by the interaction between visual elements. The old and new parts should be contrasted, but they should also be cohesive. Unity may be accomplished by the following techniques: Continuity of layout, Repetition of geometrical shapes, Balance throughout composition and appearance of completeness.

- Harmony

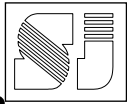
One of the characteristics of unity is harmony. It refers to the harmony of old and new in remodeled structures. Although the old and new components must be distinguished, they must also be in harmony in order to establish unity. Harmony may be produced by the use of the following techniques: similarities of elements in terms of form or shape and repetition of character with a little variety.

- Dominance

The impact of one color, texture, or aspect being visually stronger than the reminder can create dominance. A dominant form can contribute to a sense of unity. To avoid an equal competition that destroy unity, an old or new dominance is required. Dominance is utilized to disrupt the static organization of historic buildings and introduce dynamism to the structure by employing the following techniques: creating center of interest and sudden change in direction, size and shape.

- Contrast

Color or texture contrast, direction or proportion contrast, and contrast between solid and void all provide interest and vitality to a design. To break up the monotony, contrast is employed. However, too many opposing parts will degrade harmony and



generate more than one equal interest. This diminishes cohesiveness and reduces any dominance. Using too many diverse pieces results in visual chaos. The following ways can be used to produce contrast. In terms of size, form, and substance, contrast.

-Repetition

Repetition may be created by repeating forms and shapes. Any repetition pushed too far without change, on the other hand, will eventually lead to monotony and the destruction of unity. Rhythm is a very effective means of achieving harmony

- Balance

One of the characteristics of unity is balance. Nonetheless, even if all other aspects are met, a design might be unbalanced. It should be remembered that while balancing the design, symmetry should be avoided in order to avoid monotony. When integrating old and new elements, the overall composition must be balanced. Balance may be classified into two types: Informal balance in composition of layout Formal balance in composition of layout.

- Proportion- Scale

Proportion in architecture is the geometric relationship of volumes, as well as the ratio or comparison of different parts of the design. Although a proportional connection cannot be measured visually, it may be compared and used to determine the relationship of one element to another. There are several techniques to achieving proportion and size in design, including: Achieving human scale Height to width ratio Proportion between existing space and addition. When renovating heritage buildings, the combination of old and new poses a challenge. In terms of design principles, this combination refers to a physical combination. In this paragraph, principles are examined in terms of design methods based on the selected criteria. Their relationship and influence on existing buildings, as indicated in Tables (1, 2, 3, 4), have been investigated in case study analysis. Brooker and Stone, in their 2018 book, establish a taxonomy to categorize the manner in which the existing building is added to. They don't list projects by function this time, but by architectural approach. They believe that the degree of integration between the old and new may be used to classify the types of adaptation into three categories: Intervention, Insertion, and Installation.

'Intervention' is the process through which the old and new become entirely integrated each other. The sheer number of alterations to the old structure, together with the various subsequent additions, means that they can no longer be regarded separate entities. The structural and spatial integrity of the old and new are entirely dependent on one another. This does not always imply that they will employ the same language; an intervention usually resorts to pastiche. The new features are often distinct and belong to their

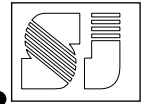
period and place. 'Insertion' is the category for a new element that is meant to fit perfectly within the limitations of an existing building. This is typically a separate and functional feature, such as a circulation core or theater. It's almost as though the new component is just dropped into position theoretically. This new part is self-contained, complete, and independent, and although being directly dependent on its host, it has its own identity. It is distinct and definite, and so distinct from the original. While the process of new additions essentially occupying space inside the limitations of the existing is known as 'Installation'. The two will have a spatial link since they occupy the same space, but the additions may be removed without altering the integrity of the original structure. This method is frequently utilized in heritage structures when considerable attention has been taken in conservation and it is critical that the fabric not be changed. They may create structures that are totally self-contained and self-supporting. They can design a modular, reversible, and interchangeable installation [17]. When designing or adapting a building, designers and architects use a strategy. This approach is the driving factor behind the design of the architecture or interior. It is the collection of guidelines developed by the architect or designer to guarantee that they have impact on the design process. The architect or designer will form an opinion or position based on an examination of the current situation. This technique might be a basic way of arranging space and form, it could control how structure is distributed inside the building, or it could be dependent on complicated contextual elements. In terms of types of additions that effect the architectural style characteristics of existing buildings, which are an important aspect in achieving a successful addition to heritage structures. Smith and Smeallie classified this type into the following:

- Appreciative Additions (Respectfully Adding On)

Additions that are respectful of the existing structure in design approach, scale, materials, and other features. This form of addition is meant to defer to the original structure; it provides essential expansion while avoiding competing architectural aims. Appreciative additions remain in the background and do not strive to overshadow the primary character in the minds of the audience.

- Different Additions: Contrast and Abstract

These types of additions complement the existing structure while still standing out on their own. Contrasting additions combine contrasting forms, colors, and other design components in a way that, when used correctly, heightens the overall impression. Abstract additions make use of design components that are a part of, but not the same as, the original. The use of contrast or abstraction in a building addition is meant to draw attention to the new



addition and make a statement about the evolution, history, image, and functions of the structure, as well as to give new meanings or connections regarding the building.

- Imitative Additions

This type tries to combine the addition with the original so that the entire structure is regarded a single unit. The architectural style, windows, height, mass, color, and materials of the original structure are all replicated. The architectural style and image of these buildings may necessitate that any addition preserve or at least not interfere with these traits. In many cases, the only type of addition conducted on buildings when the symbolic significance of the structure is as significant as the building itself [18].

The essential point to mention about additions that influence the appearance is that they must be adequately planned in order to achieve the most efficient (integrated building) feasible. Furthermore, it is sometimes advantageous to use the addition to change and improve the original building type.

In order to prove the study hypothesis, analysis and study of the experiences of exterior additions to eight local and international heritage buildings from various historical times and places. Each subjected to diverse additions and built in a different style.

- Using an evaluation form as a measurement tool (table 5). Based on the variables and indicators developed from the theoretical part of the study (1, 2, 3, 4).

- The method of analyzing case study results is based on the evaluation model's analysis of the main and secondary indicators, as well as the identification of measurement cases that are measured in case study analysis using a statistical analysis system such as relative frequency analysis, association analysis, and singular indicator analysis, as shown in Tables (6, 7, 8) and Figure (1, 2, 3, 4).

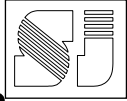
5. Results and Discussion

There is a variance in the impact of design approaches on heritage buildings (table 6), as follows: The results for the first variable indicated that the phenotype character indicator is the most influential and achievable among the indicators of the nature of additions by 87.5 %, where integration, distinctions, and balance were achieved in international examples by rehabilitating the basic elements at a minor and medium level. Local examples create repetition and balance through secondary rehabilitation such as materials, colors, and finishes, at medium level. As illustrated in Figure (1). Balance indicator is one of the most design principles of additions affecting the characteristics of the heritage building at the level of the whole composition, at a percentage of 100% in all of the selected case studies, through (height, proportions, glass and solid ratio). As illustrated in

Figure (2). The insertion indicator was among the most used techniques for additions by 50%, as it achieved compatibility between the old and the new. Where we focus the project Neues Museum, additional components (windows, columns, details) are added to compliment the building's form and create continuity rather than contradiction. As illustrated in Figure (3). Contrasting addition is the most common type in these case studies, accounting for 62.5 % of all additions, as illustrated in Figure (3). Sara building in Sulaimani, various colors and materials were employed on the façade, complimenting the building's original design. The ethnographic museum added a completely contradictory mass to the original structure. While in international examples, such as the dome of the Royal Palace in Germany, the contrast additions by using of different materials (steel structure) and contemporary technology (3D computer model). When international and local case studies are compared based on the percentage of main indicators used, local cases are more compatible than international cases with multiple uses of indicators (table 7). Where in the international cases, the compatibility was a relative coherence (neutral), that is, the use of partial repetition in the original elements. Whereas in the local cases, the compatibility was identical (copy), indicating the use of complete repetition of the original elements. T-tests was used to test the significance of the relationship between the main indicators and the secondary indicators, and the use of correlation coefficients to find the relationship between the main indicators and the secondary indicators and their direction, where if the significance level is less than (0.05), this indicates that there is an effective relationship between the indicators and needed to study of these relationships at the levels of the main indicators of selected cases. It was shown that the variable (nature of additions) and its indicators are the most effective and should be considered, as they show the levels and degrees of architectural interventions necessary for the addition process to preserve the values and historical significance of the building, as shown in (table 8).

6. Conclusion

The process of re-designing heritage buildings is ultimately a design activity, and concepts within the design vision can vary. The local experience, on the other hand, depended on duplicated and non-innovative concepts and did not produce a new idea, i.e., it was subjected to non-designed ideas, as in the project of the Great Mosque and the Anthropological Museum in Sulaimani city. As indicated in the results, the best approach to contribute to the historic fabric is to apply contemporary design methods for additions to heritage buildings. Preserve the original fabric by avoiding distortion and add to the old building



features that properly reflect for the present by employing a contemporary style. What is most crucial is to conceive a compatible relationship between the two, heritage building and contemporary addition. The addition technique is considered as the guiding force that creates the form of architecture or interior design. It is the series of rules developed by the architect or designer to ensuring that they have control the design process. The architect or designer will express an impression or viewpoint based on an analysis of the current situation. This technique might be a basic means of arranging space and shape, it could control how structure is distributed inside the building, or it could be dependent on complicated contextual factors. The results of the addition's design principles showed a difference in the relationships and visual basic elements. We can see that the local projects were influenced by changes in the consistent and morphological form, and this was an indication of the amount of stability in the visual relations. While notice a variety of models in a contemporary style, with current materials and meanings in international projects. Where there was a balance between the use of glass surfaces and steel structures with high and modern technology, as indicated in Table (1, 2). This leads to the question of how to achieve a contemporary architectural vision in heritage buildings.

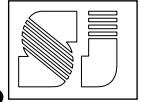
7. Recommendation

1. The study that it is essential to understand the visual dimension associated with the process of exterior addition to heritage buildings, as well as the meanings, concepts, and architectural visions that these indicators contain.
2. Studying the international experiences of addition that include strategies (expansion, rehabilitation, renovation, adaptive reuse) based on the previously mentioned design principles, and attempting to benefit from them, avoid mistakes that have been made, evaluate them, and capitalize on their advantages.
3. The study suggests using the nature of the elements, technological procedures, and contemporary materials in the process of adding to the local structure in a way that is consistent with the context.
4. More detailed guidelines on the factors that should be taken into consideration when adding to a historic building should be developed in order to ensure a cohesive relationship between historic structures and their contemporary additions.

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تأثير الإضافات الخارجية على علاقات التصميم المتناسكة: المباني التراثية في مدينة السليمانية كحالة دراسية

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المستخلص

تعتبر الإضافات من المفاهيم المهمة التي رافقت تاريخ الحضارات الإنسانية منذ القدم. إنه يمثل منتجاً حضارياً يجسد الإدراك البشري وكذلك المطالب الاجتماعية والنفعية عبر التاريخ. يجلب التصميم للسياق التاريخي تحديات بطبيعته ويتطلب فهماً شاملاً وتحليلاً متعاطفاً لجميع جوانب الهيكل أو المباني الحالية. قد يساعد الفهم الشامل لطبيعة الهياكل التراثية ، وكذلك فلسفة الحفظ ، في توجيه التدخلات أو الإضافات الجديدة. سيؤدي إلى عملية تكيف أكثر كفاءة ، مع الحفاظ على الخصائص الأصلية أثناء تطوير البنية الجديدة. الهدف من هذه الدراسة هو تحديد مدى توافق التعبير المعماري للإضافة الجديدة فيما يتعلق بخصائص المبنى التاريخي. تعتمد هذه التقنية على التحليل المعماري والإحصائي ، الذي يأخذ في الاعتبار الطابع التراثي للهيكل التراثي فيما يتعلق بقيمته. وفقاً للنتائج ، يجب أولاً تحديد طبيعة الإضافات بوضوح ، ويجب أن تعكس كل إضافة جديدة تحديد زمنها. بدلاً من تغيير مقياس أو شكل الهيكل القديم ، يجب أن تكون إضافة جديدة مكملة وتساهم في الشعور بالتناسب والعاطفة والتكوين التاريخي.

الكلمات المفتاحية:

تدخلات الإضافة للمباني التراثية، علاقة التوافق، الطابع التراثي، قيم المبنى التراثي، إضافة مكملة

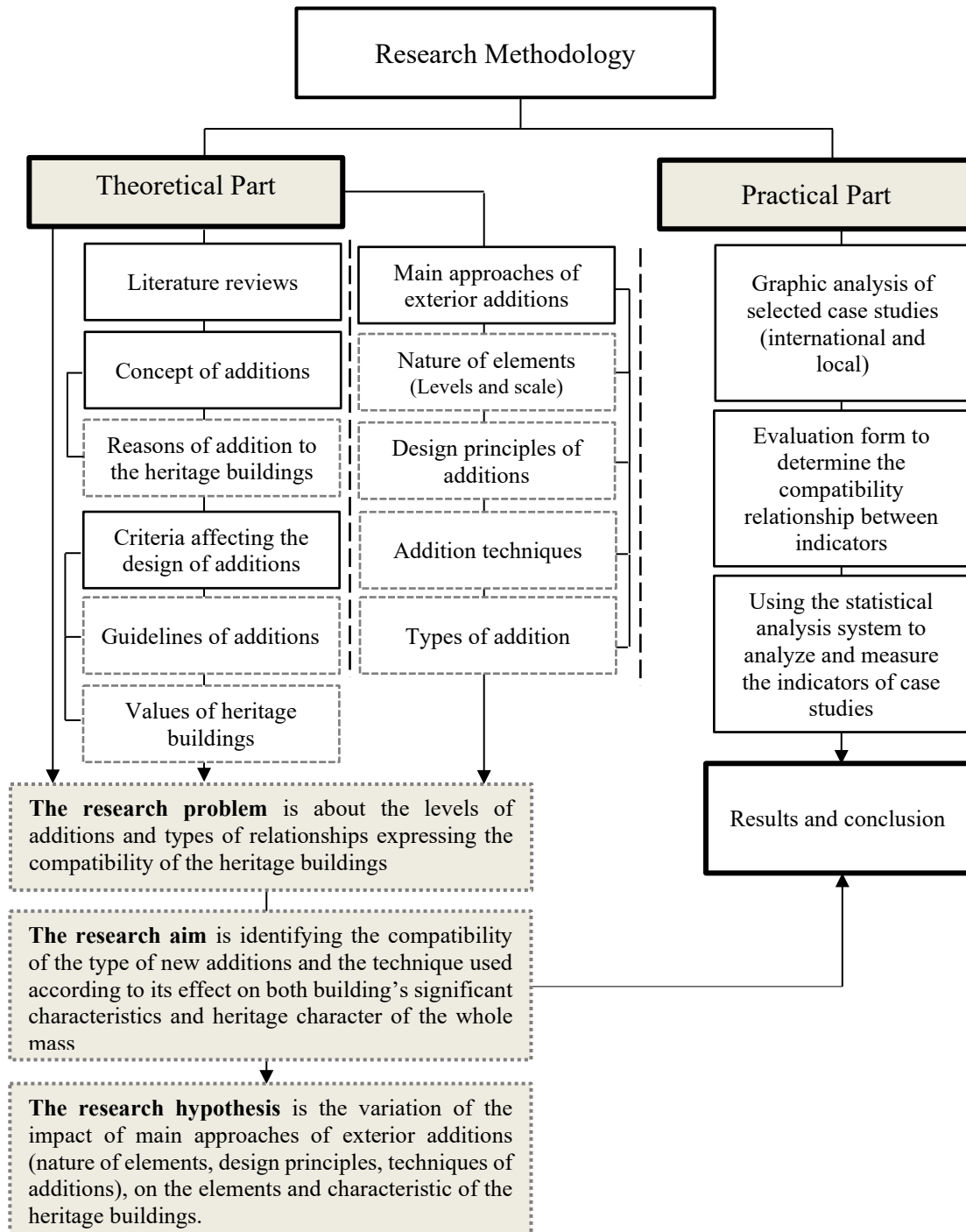
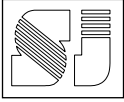


Diagram 1: illustrates the framework of the study (researcher)

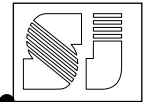


Table 1: Analysis of International Heritage Buildings (researcher)


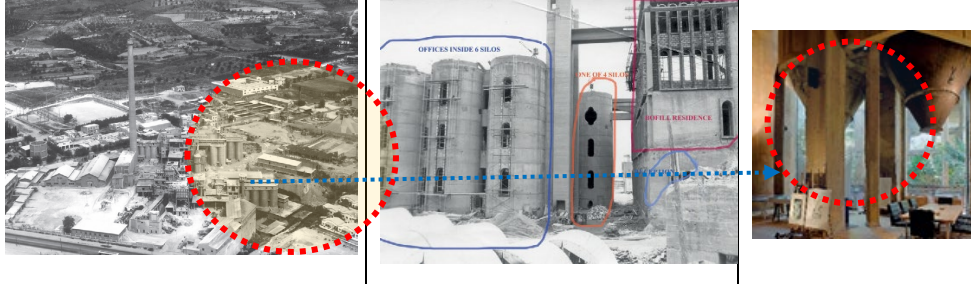
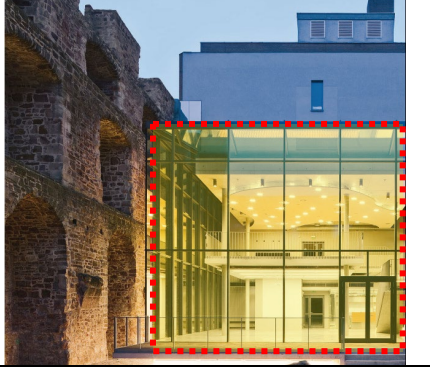
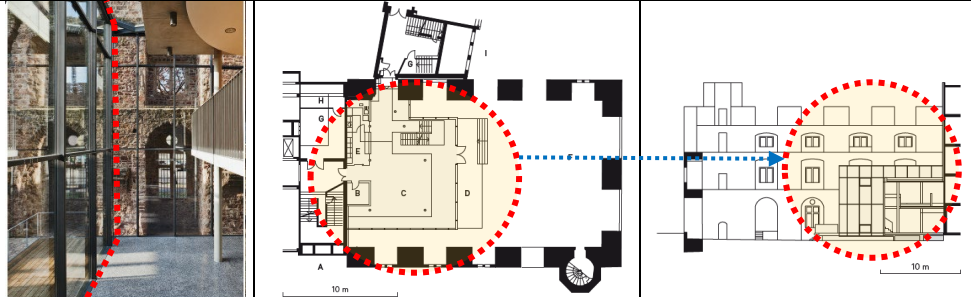
1. The Cement Factory / La Fabrica [17]		
OLD	Cement works	
NEW	Family home and studio	
Location	Barcelona- Spain	
Technique and nature of Addition	<ul style="list-style-type: none"> - Many of the structures that had been added to the factory's main elements (substantial level). - The Cement Factory was reused and rehabilitated using insertion techniques. 	
Design principle and type	<ul style="list-style-type: none"> - The exposed monumental surfaces of the concrete structure provided an emotional backdrop for the new features of the house and office, as well as an overpowering reminder of the building's previous function, which relied primarily on unity, harmony, repetition and balance principles through the use of appreciative additions. 	
Images of the Project illustrates design approaches of addition		
2. Kassel Building Department Hans-Joachim Neukäter [10]		
OLD	Historical Armory- Zeughaus ruin-1582	
NEW	Resturant and Bar- 2008	
Location	Berlin- Germany	
Technique and nature of Addition	<ul style="list-style-type: none"> - Although it is closely linked to the existing material, the installation of a cafeteria with a free-standing building within the ancient armory walls. - Because of the installation of glass mass within the structure, the level employed in this building was mass aggregate formations at medium scale. 	
Design principle and type	<ul style="list-style-type: none"> - The cafeteria's Level 1 (ground floor), which is half a meter taller than the previous floor, the set-back mezzanine level above, and the roof slab are all part of the architectural concept (Inside and outside relate to old and new). Primarily based on the principle of domination. - The contrast addition type was used to complement the existing structure. 	
Images of the Project illustrates design approaches of addition		

Table 2: Analysis of International Heritage Buildings (researcher)

3. Neues Museum [19]		
OLD	Historical Armory- Zeughaus ruin-1582	
NEW	Resturant and Bar- 2008	
Location	Berlin- Germany	
Technique and nature of Addition	<ul style="list-style-type: none"> - The insertion technique used, where new elements have been added to recomplete the building so that its original structure and layout are readable again (continuity rather can contrast). - The medium scale of addition was used, and the addition influenced the entire composition. 	
Design principle and type	<ul style="list-style-type: none"> - The new and the old combine to generate a visually appealing entity that incorporates design principles from (unity, repetition, and harmony). It has restored the structure's original volume, as well as the façades and space sequence. - Using imitative addition, a combination of conserving the fabric and recomposing and restoring missing parts. 	
Images of the Project illustrates design approaches of addition		
4. Roof for the Kleiner Schlosshof [10]		
OLD	Dresden's Royal Palace - 1547	
NEW	Museum- 2010	
Location	Dresden- Germany	
Technique and nature of Addition	<ul style="list-style-type: none"> - The intervention technique used at the minor level of a trussed dome addition. - A self-supporting lattice shell based on a rigid node lattice. Allowing as much natural light as possible into the building's courtyard. 	
Design principle and type	It is primarily based on the principles of (dominance, contrast not to human scales, and balance). Its geometry was created using a three-dimensional computer model (contrast addition). Using cad to achieve precision.	
Images of the Project illustrates design approaches of addition		

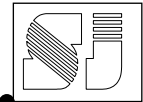


Table 3: Analysis of Local Heritage Buildings (researcher)

5. The Great Mosque [20]		
OLD	Mosque-built in 1784	
NEW	Mosque- 2010 (restoration and maintenance)	
Location	Iraq, Sulaymaniyah city center	
Technique and nature of Addition	<ul style="list-style-type: none"> - The intervention technique of adding new elements while keeping the overall composition preserved. - A small degree of addition is employed as a minor improvement that has an impact on the overall composition of the building. 	
Design principle and type	<ul style="list-style-type: none"> - Restoration: Parts of the mosque were renovated in order to preserve the mosque's original shape, which was accomplished through the use of contrast and imitative addition. - Duplication: The Minaret, arches, and dome, as well as portions of missing or damaged architectural components in the mosque, were replicated primarily using (unity, repetition, balance, and proportion) principles. 	
Images of the Project illustrates design approaches of addition		<p>The volumetric transformation of the architectural composition (after restoration) by combining elements of several different styles</p>
6. Sara Building [21]		
OLD	Governmental building- 1784	
NEW	Museum- 2012	
Location	Iraq, Sulaymaniyah city center	
Technique and nature of Addition	<ul style="list-style-type: none"> - The insertion of elements and additions during the restoration and reconstruction process at various historical phases. - On a small scale, minor improvements to addition were applied. 	
Design principle and type	<ul style="list-style-type: none"> - The aim is to keep the main structure and restore the original parts with new additions that harmonized in with the surroundings and included Kurdish style elements. Focused mostly on the principles of (unity, harmony, repetition, balance, and proportion). - The materials, forms, and colors utilized in the façade contrast, providing the façade rhythm, where imitative addition is applied. 	
Images of the Project illustrates design approaches of addition		
[22]		

Table 4: Analysis of Local Heritage Buildings (researcher)

7. Hotel Farah [23]		
OLD	Oldest hotel in Sulaymaniyah, was built between 1932 and 1934.	
NEW	Retail shops and Cultural Revival Organization. Renovated between 2013- 2015	
Location	Iraq, Sulaymaniyah city center- Mawlawi street	
Technique and nature of Addition	The insertion technique was used to create extra aspects such as the balcony, ceilings, and roof corners for the heritage building's renovation. - On a small scale, minor improvements to addition were applied.	
Design principle and type	<ul style="list-style-type: none"> - The use of brick and wood material in construction and finishing. - There is a contrast in the materials, shapes and colors used in the façade. - Openings were treated by dividing them into distinct forms, colors, and sizes. - Giving a rhythm to the facade by repeating the arch in the block and in the balconies. - using contrast and imitative addition. 	
Images of the Project illustrates design approaches of addition		
8. Ethnographic museum [20]		
OLD	In 1920, the house was renovated and repurposed	
NEW	Museum- Krieg, a German firm, completed the final refurbishment in 1990	
Location	Iraq, Sulaymaniyah city center- Near the University of Sulaymaniyah	
Technique and nature of Addition	<ul style="list-style-type: none"> - Using the intervention technique, the museum was given a new function as a directorate, as well as an extension. - Substantial modifications are implemented on a medium scale of addition. 	
Design principle and type	<ul style="list-style-type: none"> - The element's dominance within the overall form, with a partial alteration in its original shape - By employing contrast and abstract addition type, the façade merges old and new designs. 	
Images of the Project illustrates design approaches of addition		<p>Maintaining the heights consistent with the overall composition</p>

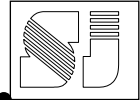


Table 5: Evaluation form for identifying the main/secondary indicators of study (researcher)

Main Variables		The main indicators of the study		Selected Case Studies								
		Secondary variables	Indicators	International Case Studies				Local Case Studies				
				1	2	3	4	5	6	7	8	
Nature of additions (Levels and scale)	Levels	Phenotype character	Elements affect the whole	•		•	•	•	•	•	•	•
			Alter visual perception	•								
	Scales	Mass aggregate formations	Arrangements of parts within the whole	•	•						•	•
			Small	Minor improvement				•	•	•		
			Medium	Substantial changes	•	•	•					•
	Large	Drastic remodeling										
Design principles of additions	Unity	Continuity of layout	•		•				•	•		
		Repetition of geometrical shapes	•		•			•	•	•	•	
		Balance throughout composition	•	•	•	•	•	•	•	•	•	
		Appearance of completeness	•	•	•	•				•		
	Harmony	Similarities of elements in terms of shape	•		•				•	•	•	
		Repetition of character with a little variety	•		•				•	•	•	
	Dominance	Creating center of interest	•	•		•						
		A sudden change in direction, size, material or shape	•	•		•	•					•
	Contrast	In terms of size, shape, direction, material, position		•		•					•	•
	Repetition	Repetition of existing layout	•		•				•	•	•	•
	Balance	Formal balance in composition	•	•	•	•	•	•	•	•	•	•
	Proportion	Parts together			•				•	•		•
		Part with all	•	•		•				•	•	
	Scale	Human scale							•	•	•	•
Not human scale		•	•	•	•							
Addition techniques	Intervention	Integration between old and new	•			•						•
	Insertion	Fit perfectly within the limitation of old			•			•	•	•		
	Installation	Self-supporting, reversible and interchangeable		•	•							
Types of additions	Appreciative additions	Preserve existing character	•									
	Contrast and abstract additions	Complement the existing structure		•		•		•		•	•	
	Imitative additions	Duplicate the original characteristics			•			•		•	•	

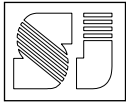


Table (6): Evaluate the reviving of Heritage Buildings according to the main and secondary indicators (researcher)

Main Terms	Secondary variables		Indicators	Percent
Nature of additions (Levels and scale)	Levels	Phenotype character	Elements affect the whole/Alter visual perception	87.50%
		Mass aggregate formations	Arrangements of parts within the whole	50.00%
	Scales	Small	Minor improvement	50.00%
		Medium	Substantial changes	50.00%
		Large	Drastic remodeling	0.00%
Design principles of additions	Unity		Continuity of layout	50.00%
			Repetition of geometrical shapes	75.00%
			Balance throughout composition	100.00%
			Appearance of completeness	62.50%
	Harmony		Similarities of elements in terms of shape	62.50%
			Repetition of character with a little variety	62.50%
	Dominance		Creating center of interest	37.50%
			A sudden change in direction, size, material or shape	62.50%
	Contrast		In terms of size, shape, direction, material, position	50.00%
	Repetition		Repetition of existing layout	75.00%
	Balance		Formal balance in composition	100.00%
	Proportion		Parts together	50.00%
	Scale		Part with all	62.50%
			Human scale	50.00%
Not human scale			50.00%	
Addition techniques	Intervention		Integration between old and new	37.50%
	Insertion		Fit perfectly within the limitation of old	50.00%
	Installation		Self-supporting, reversible and interchangeable	25.00%
Types of additions	Appreciative additions		Preserve existing character	25.00%
	Contrast and abstract additions		Complement the existing structure	62.50%
	Imitative additions		Duplicate the original characteristics	50.00%

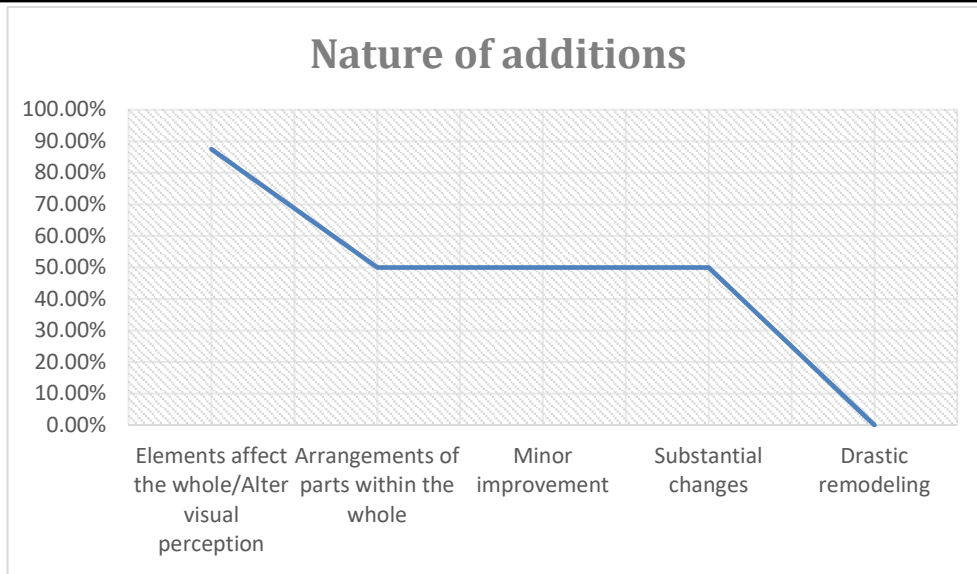
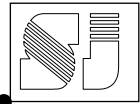


Fig (1): Evaluate the reviving of Heritage Buildings According Nature of additions (researcher)

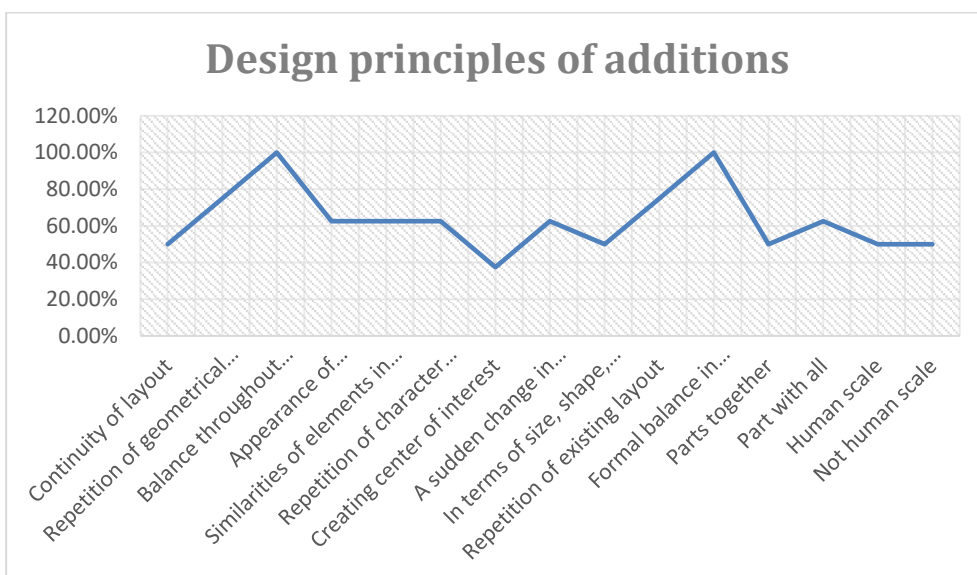


Fig (2): Evaluate the reviving of Heritage Buildings According Design principles of additions (researcher)

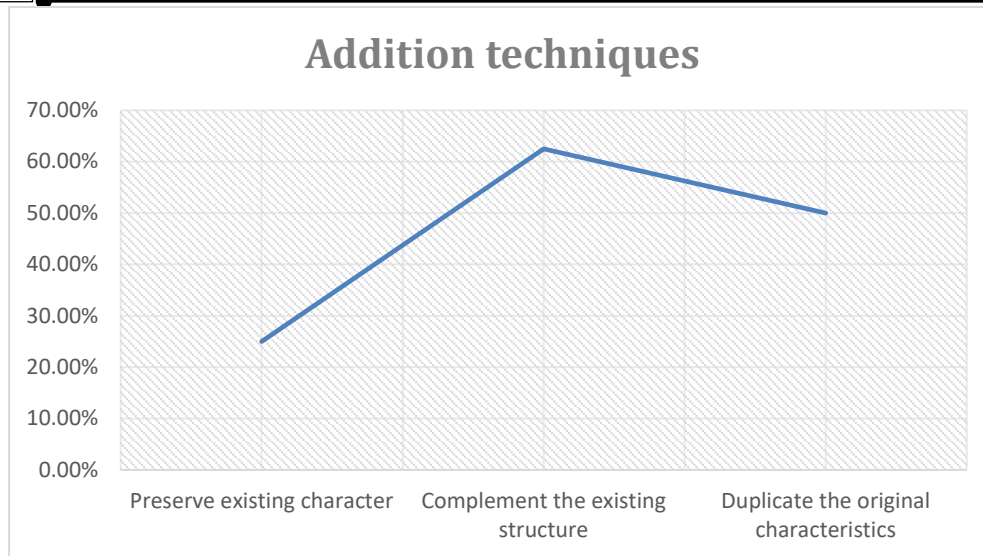


Fig (3): Evaluate the reviving of Heritage Buildings According Addition techniques (researcher)

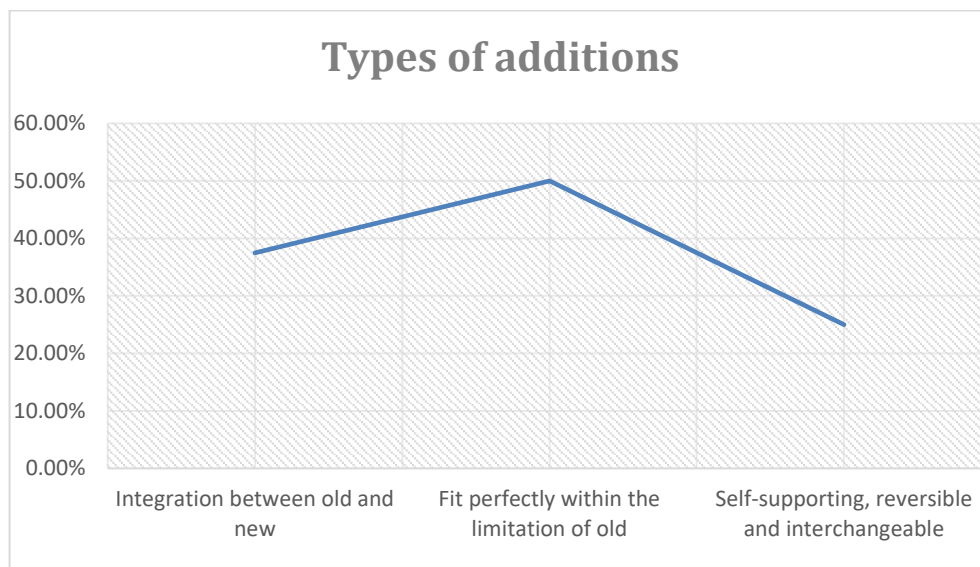


Fig (4): Evaluate the reviving of Heritage Buildings According Types of additions (researcher)

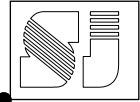


Table (7): The role of indicators within case studied (researcher)

	Selected Case Studies							
	International Case Studies				Local Case Studies			
	1	2	3	4	5	6	7	8
The percent of main indicators of the study	65.38%	46.15%	61.54%	46.15%	53.85%	53.85%	65.38%	50.00%

Table (8): The results of the analysis of relations between the main indicators and secondary indicators (researcher)

Main Variables	The main indicators of the study		Correlation Coefficient	t-test	p-value	
	Secondary variables - X	Indicators - Y				
Nature of additions (Levels and scale)	Levels	Phenotype character	0.590	4.505	0.000	
		Mass aggregate formations				Elements affect the whole/Alter visual perception
	Scales	Small				Arrangements of parts within the whole
		Medium				Minor improvement
		Large	Substantial changes			
			Drastic remodelling			
Design principles of additions	Unity	Continuity of layout	0.630	2.925	0.012	
		Repetition of geometrical shapes				
		Balance throughout composition				
		Appearance of completeness				
	Harmony	Similarities of elements in terms of shape				
		Repetition of character with a little variety				
	Dominance	Creating centre of interest				
		A sudden change in direction, size, material or shape				
	Contrast	In terms of size, shape, direction, material, position				
	Repetition	Repetition of existing layout				
	Balance	Formal balance in composition				
	Proportion	Parts together				
Scale	Part with all					
	Human scale					
	Not human scale					
Addition techniques	Intervention	Integration between old and new	0.370	1.868	0.075	
	Insertion	Fit perfectly within the limitation of old				
	Installation	Self-supporting, reversible and interchangeable				
Types of additions	Appreciative additions	Preserve existing character	0.450	2.364	0.027	
	Contrast and abstract additions	Complement the existing structure				
	Imitative additions	Duplicate the original characteristics				