

Measurable Mistakes in Architecture the Effect of Designer's Experience on the Propagation of Mistakes in Architectural Design - Residential Buildings in Al Sulaymaniyah City as a Case Study

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ABSTRACT

The importance of physical and nonphysical architectural design values made architectural designers need good experience to be experts of architectural values reasonably without neglecting any value in the design process. The importance of such values made that ignoring any values and mistakes occurs in the design process. Simultaneously, architectural designers' different nature and the difference in their experiences are causing different understandings of the design values, thus causing architectural mistakes. The research problem appears from the randomly propagating of mistakes in contemporary architecture, which is about to become a phenomenon in Al Sulaymaniyah city. The research aims to find the main reasons and influences of making architectural mistakes and propagating such mistakes in the contemporary architectural design depending on randomly selected samples. The study took the factor of "Architectural Designers' Experience" as an influential factor in avoiding the propagation of architectural mistakes. To see architectural mistakes in real existing cases, the research took some of the different types of residential buildings in Al Sulaymaniyah city designed during (2000-2010) as case study to show architects' architectural mistakes in residential buildings.

Keywords: Architecture design, Design values, Mistake, Experience

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الخطأ المقيس في العمارة اثر خبرة المصمم في شيوع الاخطاء في التصميم المعماري ابنية سكنية في مدينة السليمانية حالة دراسية

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الخلاصة

أهمية قيم التصميم المعماري المادية واللامادية جعلت المصممين المعماريين بحاجة إلى خبرة جيدة ليكونوا مصممين جيدين في طبيعة القيم المعمارية وعدم تجاهل أي منها في عملية التصميم. وأهمية هذه القيم تجعل من تجاهل أي منها سببا في حدوث الأخطاء في عملية التصميم. في الوقت ذاته، فإن تباين طباع المصممين المعماريين واختلاف خبراتهم يتسبب في تباين فهمهم لقيم التصميم، والذي يتسبب بحدوث الأخطاء المعمارية. تكمن مشكلة البحث في الانتشار العشوائي للأخطاء في العمارة المعاصرة، والتي توشك أن تصبح ظاهرة في مدينة السليمانية. ويحاول البحث إيجاد الأسباب والمصادر الرئيسية لارتكاب الأخطاء المعمارية وانتشارها في التصميم المعماري المعاصر، وذلك بالاعتماد على عينات مختارة عشوائيا. وقد أخذ البحث عامل "خبرة المصممين المعماريين" كعامل فعال لتجنب انتشار الأخطاء المعمارية. ولدراسة الأخطاء المعمارية في الواقع الحالي، أختار البحث بعض الأنواع المختلفة من المباني السكنية في مدينة السليمانية، والمصممة في المدة بين عامي (2000-2010) حالة دراسية، وذلك لإظهار الأخطاء المعمارية التي ارتكبتها المهندسون المعماريون في المباني السكنية.

1. INTRODUCTION

When architecture is mentioned, the architectural designer is the first to appear behind it and responsible for it. Architecture is the fingerprint of architects all over the world since architecture is that aspect (phenomenon) in which the architect works on and tries to use all of his/her efforts to get an architectural product free of any faults from all respects. Since architecture is the response to both physical and unphysical aspects, architects have to consider both physical and unphysical design values during the design process. It is evident that designers do not have the same ideas and concepts in the design process; therefore, designers differ in responding to the physical and unphysical design values, which makes variety in styles and typologies in the architectural design process. It is evident that the design process is a multi-value activity in the architectural field, and the role of the successful designer can be seen in making the right decision in the design process regarding all architectural design values. When a designer decides, that decision is related to all architectural design values in using and keeping them. It is known that architectural design does not include only one aspect. Still, it includes many essential aspects known as architectural design values. That's why designers always have to be very careful about design values during design process.

The importance and numerous architectural design values impose a good experience for designers to understand the nature of all design values and give the right to each value during the design process. That is why designers always have to be very careful about design values during the design process because neglecting any value would result in a diminution in the design process; thus, mistakes would occur in architecture.

From here, the research problem can be summarized as:

- Appearing and propagating mistakes in contemporary architecture randomly in the present time is about to become a phenomenon.
- Inaccuracy of less experienced designers in the design process and neglecting simple mistakes during process.

The research aims to:

- Find the main reasons for making and propagating mistakes in contemporary architecture to overcome their propagation.
- Find methods to avoid the propagation of common mistakes in contemporary architecture.



- To make designers know more about the nature of common mistakes in architecture to avoid making common mistakes in their designs.

The research hypothesized that:

- Since there are several architectural design values, and each value includes a wide range, it couldn't be said that there is an absolute correct architectural product without any mistakes.
- Experienced architects have an essential role in reducing the propagation of mistakes in contemporary architectural design.

To prove the research hypotheses, the study follows an Induction methodology through an analytical method which includes graphical analyses for randomly selected different types of housing buildings in Al Sulaymaniyah city and comparing with architectural standards to show architectural mistakes made by architectural designers which are related to the physical design, the analyzing process to diagnose mistakes is not according to the researchers' opinion but it is according to the standard cases which are stated in the case study.

1.1 Architectural Design and its Characteristics:

Regarding the definitions of design, the research returns to David Pye's (The Nature of Design 1964) and (The Aesthetics of Design 1978). Pye gives a wonderfully rounded account of the evolution and design of artifacts, bringing together the requirements of materials available, the crafting of the object, and the object's final function: form, function, and the process of making are all given importance. Pye links design and making as two of the principal human activities. In posing good design, he differentiates it from painting and sculpturing because of the limits arising from the function, which leads to a discussion of the link between form and function (**Wender and Roger, 1995**). He differentiates between "inventions", the process of discovering a principle and "design", the process of applying that principle, and points out designer can only design if he is capable of making reasonable preliminary assumptions based on experience. Pye discusses design as a "problem solving activity" but argues that this is a partial and inadequate view as Design is Problem solving Plus art. There are no perfect solutions, and most design problems are essentially similar (**Foo, 1999**). Many attempts have been made to define architectural design. Some define it in terms of specific well-established fields. Kilmer states that "Design is the organized arrangement of one or more elements and principles (e.g., line color or texture) for a certain purpose". (**Kilmer, 1992**), but Rowe (1987) points out that design is often located in an ambivalent position between the forms of fine art and technical science (**Labuda, 2015**) (**Rowe, 1987**), while Vitruvius asserts that the primary factors of architecture are providing firmness, commodity, and delight (**Rowe, 1987**). Later and still accepted is that the theory of evaluating successful designs is more or less based on Vitruvius' three factors of architecture and emphasizes one of these factors. One example is that contemporary linguistic studies use similar terms (syntactic, pragmatic, and semantic) to Vitruvius. Current curricula of architectural schools and design professions' principles suggest that there are at least five essential components in design: aesthetics, culture, environment, structure and materials, and economics and social influence (**Rowe, 1987**) and (**Faizi and Khakzand, 2009**). Designers are expected to consider these components throughout every phase of the design process. According to Krishan's study, the design process attempts to use optimum solutions at various levels to create concepts by collecting and classifying the appropriate responses in terms of providing the goals of designing. (**Krishan et al., 1998**)

At the same time, the design is the organized arrangement of one or more elements and principles (e.g., line color or texture) for a purpose (**Kilmer, 1992**). Design elements and principles describe



fundamental ideas about the practice of good visual design that are assumed to be the basis of all intentional visual design strategies. The elements form the 'vocabulary' of the design, while the principles constitute the broader structural aspects of its composition (**Emmison and Smith, 2000**). Awareness of the elements and principles in design is the first step in creating successful visual compositions. These principles, which may overlap, are used in all visual design fields, including graphic design, industrial design, architecture, and fine art (**Simithies, 1981**). Design elements are the basic units of a visual image. These elements include: (**Kilmer, 1992**). Design elements are the basic units of a visual image. These elements include (Point, Line, Plane, Volume, Colour, Texture, and Value (Tone)) (**Kilmer, 1992**). The principles of design are as varied as attitudes regarding modern design (**Salih, 2019**). They differ both between the schools of thought that influence design and between individual practicing designers. Generally, the main design principles are; Unity (Repetition, Continuation, Closure), Focal point (Contrast, Isolation, Placement, Absence of focal point), Balance (Symmetrical, Asymmetrical, Radial, All patterns), Proportion/Scale, Contrast, Movement, Rhythm/pattern, Variety, and Harmony. (**Kilmer, 1992**)

1.1.1 Architectural design Values:

Architectural design values comprise basic parts of what influences the architect and designer when they make their design decisions. However, architects and designers are not always affected by the same values and intentions (**Parsaee et al., 2016**). Value and intentions differ between different architectural movements. Among design values, aesthetic value is somewhat different from others as it is related to aesthetic science and philosophy, where the mistake is not measurable in such value. Instead, aesthetic taste and other aesthetic values participate in aesthetic judgment (**Andrw, 2007**). It also differs between different schools of architecture and schools of design and individual architects and designers (**Holm, 2006**). The differences in values and intentions are directly linked to the pluralism in design outcomes within architecture and design. It is also a significant contributing factor to how an architect or designer operates in his/her relation to the clients (**Xu et al., 2018**). Different design values tend to have a considerable history and can be found in numerous design movements. The influence that each design value has had on design movements and individual designers has varied throughout history. Many important architectural design values must be taken into account during the design process, and neglecting them may result in mistakes, errors, or inappropriate design processes. Architectural design values include physical design values such as (functional, structural, material honesty, standard, etc.) values unphysical design values such as (aesthetic, symbolic, poetry, conservation, etc.) design values (**Holm, 2006**). The most important architectural design values include:

- **Social Design Values**
- **Environmental Design Value**
- **Traditional Design Value**
- **Gender-Based Design Value**
- **The Economic Design Value**
- **The Novel design Value**
- **Mathematical and Scientific Design Values**
- **Legislation Design Values**
- **Religious Design Values**



1.2 Architectural Mistakes:

An error is an unintentional deviation from an accepted standard, while a violation is a deliberate deviation from the standard. Human errors fall into three groups; slips, lapses, and mistakes, which can be further sub-divided into rule-based and knowledge-based mistakes (Hughes, 2007). Mistakes are errors in choosing an objective or specifying a method of achieving it (Reason, 1990). Mistakes occur when an incorrect action occurs, but the person involved believes the action is correct. Therefore any mistake involves an incorrect judgment. There are two types of mistake: (Hughes, 2007)

- Rule-based Mistakes
- Knowledge-based Mistakes

Mistakes need not have to have fatal consequences but can also be a source of new ideas. In scientific research, 'trial and error' is an acknowledged method, but in architecture, a one-time error may cast a long shadow on future trials (Forlati, 2006). Mistakes found in architecture are all due to human errors, which may cause direct mistakes or indirect mistakes in the design process. Making mistakes every time architects do things enables their capacity to experience insight (Diego, 2019). In many cases, mistakes might cause architectural distortion as according to (Abdullah and Shari, 2019). There are many types and levels of distortion of buildings' facades, starting with their problems in terms of formal organization and unity and harmony of elements or color coordination and the adequacy of materials and finishing.

1.2.1 Who Makes Mistakes in Architecture?

Mistakes found in architecture are all due to human errors, which may cause direct mistakes or indirect mistakes in the design process. The human category mistake (error) in architecture falls into five classifications; (Hughes, 1991)

- Designer's mistakes
- Owner's (client) mistakes
- User's Mistakes
- Society's' Mistakes
- Executer's Mistakes

1.2.2 Types of Mistakes in Architecture:

According to design values, there are two main types of mistakes in architectural design;

- Distortion in Unphysical Design Values

It is a change in a body or drawing or any architectural form, either by man or nature or circumstances, from good to bad and from beautiful to ugly, or giving a picture that is not identical to the reality of the thing (Abdullah and Shari, 2019). This distortion falls in the unphysical category of mistake, mostly found in unphysical design values, where most of the designers fall in mistakes in unphysical properties like aesthetic value, artistic values, and poetic values, regionalism value, simplicity value, etc.. In contrast, such kind of mistakes is not taken in the study.



- Measurable Mistakes in Physical Design Values:

These mistakes are much more common in architectural design since the determinations of such mistakes are in the physical values of architectural design. The diagnosing of such mistakes is much more direct than those of unphysical mistakes since physical properties' measuring process is more direct than unphysical properties.

The most common types of physical mistakes in architecture can be measured as the following:

- **Structural Mistakes.**
- **Functional Mistakes.**
- **Mistakes in Architectural Standards.**
- **Mistakes in Proportional Use.**
- **Material Honesty Mistakes.**
- **Environmental Mistakes**
- **Healthy Property Mistakes**
- **Traditional Preservation Mistakes**
- **Traditional Preservation Mistakes**
- **Economic Mistakes**
- **Legislation Value Mistakes**
- **Religious Value Mistakes**

1.3 Design Process and designers Experience:

Experience underlies all kinds of human knowledge and determines how people interact with products and environments (Ayudhya, 2015). It also influences designers' knowledge and their design process (Ashton, 1998). An issue not fully addressed in the current literature is how designers' individual experience affects design tasks (Marianella, 2000). Designers' experience, the design process, and participatory design have been extensively investigated in design research. Designers' experience has been studied from various perspectives. Much of these efforts have focused on the design thinking and reflective aspects embedded in the process of making visual representation of design concepts. The use of visuals in design research has helped investigate the design process and investigate knowledge and experience revealed by them (Dahl *et al.*, 2001) (Azodo *et al.*, 2019). People's experience within a particular social, cultural, and physical context-of-use determines how they interact with products. Alben, in 1996, developed a set of criteria for assessing the quality of designers' experience in order to judge Design Awards entries for interactions. The jury was interested in how effective interaction design could provide people with successful and satisfying experiences. The criteria fall into two categories: those that directly have an impact on designers' experience (e.g., learnable and usable) and those that make their contribution indirectly (e.g., understanding of users and effective design process). (Alben, 1996) The criteria are:

- **Understanding of the designer**
- **Effective design process**
- **Needed**
- **Learnable and Usable**
- **Appropriate**
- **Mutable**
- **Manageable**



These criteria provide an overview of selecting characteristics of designs that provide satisfying experiences for users through their interactions.

2. The Case Study:

This part includes a graphical analysis of selected residential buildings in Al Sulaymaniyah city to show and analyze architectural mistakes made by designers in physical design values compared to the correct cases according to architectural fundamentals and standards.

2.1.1 Components of the Case Study:

This part discusses the procedures and steps that the research has followed in the case study. It aims to achieve the research goals, starting with mentioning the stages of the case study. In each stage, the research population and its sample, searching tool, the analyzing units, finally the result treatment and analyzing would be determined. The case study includes two stages: the first one is preparing the questionnaire. The second one is graphical analysis for the selected residential samples of the determined population with respect to the design process and architectural mistake.

First Stage: Preparing the Questionnaire:

The questionnaire comprises two parts; one of them is related to measurable mistakes in architecture in Al Sulaymaniyah city and the other is related to mistakes in architectural design values. Both parts include some questions based on terms and indications that the research's theoretical parts have concluded. The questions are derived from the abstracts of the previous parts' research terms and formed as questions relating to the previous axes. Since the architecture mistake is related to the architectural design process, architects are the best persons who understand the design process. At the same time, architects can find out and diagnose architectural mistakes specifically, therefore, the research population is divided into two architectural classes that are:

- Architects in general: 75 questionnaire forms (the questionnaire form attached) are delivered to random samples of architects living in Al Sulaymaniyah city, where 60 forms were returned back and completely filled as this number is suitable, and it is an acceptable ratio according to the population size.
- Architects that work in the academic field: 25 questionnaire forms (the questionnaire form attached) delivered on the architects working in the academic field at the architectural department at Al Sulaymaniyah University. This form is related to architectural designer's possibility to make mistakes in architectural design values for two types of buildings, where 20 forms were returned backed and filled completely as this number is suitable, and it is an acceptable ratio according to the population size. The result of the questionnaire could be summarized in some points;
- The Axis of the Design Process in Al Sulaymaniyah City:

The form included some questions about the architectural design process in Al Sulaymaniyah city that consider the nature of the design process applied in Al Sulaymaniyah city through architects' works, in a general question about working in design in the team (design group). The answered samples were; 44% of them are mostly working in a team, 38% are rarely working in a team, and 18% are never working with a team. The answers show that designers mostly work in a team during the design process, while architects work alone and architects who rarely work in a team



during the design process. In a question relating to the evaluation of buildings designed in Al Sulaymaniyah city in terms of architecture, the answers were as following: According to the architects, buildings are mostly badly designed since this answer's ratio is 90%. Still, the ratio of answers about buildings' well designed is only 1.7%, and 8.3% think that the buildings that are well designed are equal to the buildings that are badly designed, as shown in **Tables 1 and 2.**

Table 1. The ratio of questioners' opinion about the reasons for finding diminutions in buildings in Al Sulaymaniyah city (**Prepared: Researchers**).

Main reasons for finding diminution in the buildings in Al Sulaymaniyah city	Has no effect (%)	Has little effect (%)	Has a medium effect (%)	Has a big effect (%)
a) Most designers are not very curious in their works	0	10	21.7	68.3
b) Mostly, the designers are inexperienced and are not experts in the design process.	0	8.3	33.3	58.4
c) The different scope of practice in the design process.	1.7	8.3	11.7	78.3
d) Mostly, the execution of the buildings are not very curious	0	6.7	21.6	71.7
e) Mostly, society doesn't care about the architecture	0	10	28.3	61.7
f) Mostly, the economic factor.	1.7	16.6	56.7	25

Table 2. The ratio of questioners' opinion about the reasons for finding diminutions in buildings in Al Sulaymaniyah city (**Prepared: Researchers**).

No.	Items	The ratio of Questioners' Opinion (%)
1.	How long have you been working as an architect?	
a	1-5 years	51.7
b	6-10 years	23.3
c	11-15 years	3.3
d	Above 15 years	21.7
No.	Items	Ratio of Questioners' Opinion (%)
2.	What is your title in your job?	
a	Architectural Designer	73.3
b	Planner	10
c	Consultant architect	16.7
d	Draftsman	0
3.	Do you work in a group in a design team?	
	Yes, I am mostly working in a group in a design team	44
	I am very rarely working in a group in a design team.	38
	I have never worked in the design team (I work alone).	18
4.	How do you evaluate the architectural side of the buildings in Al Sulaymaniyah city?	
a	Buildings are mostly well designed.	1.7
b	Buildings are very rarely well designed.	90
c	The buildings that are well designed are equal to the buildings that are badly designed.	8.3
d	I don't know.	0
5.	Do you think that there is a diminution in the architectural design of the buildings in Al Sulaymaniyah city?	
a	Yes, there are many diminutions.	96.6
b	There are very little diminutions.	1.7
c	There isn't any diminution.	1.7
d	I don't know.	0



6.	If there is a diminution in the design of buildings in Al Sulaymaniyah city, in which field can you find so much? (you can choose more than one answer)	
a	Mostly in architectural design.	65
b	Mostly in the structure.	28.3
c	Mostly in the execution process.	90
d	Mostly in the building use.	38.3

According to the asked architects, most of the buildings designed in Al Sulaymaniyah city are not designed very well. This answer may indicate the existence of mistakes in the designs of buildings in Al Sulaymaniyah city for certain reasons that the research will show in later parts that are effective factor axes in making mistakes in architecture.

B: Axis of Mistakes and Making Mistakes in Architecture in Al Sulaymaniyah City:

This axis shows the existence and making mistakes in the buildings in Al Sulaymaniyah city. In a general question about occurring mistakes in architecture, 83.3% of the questioners have answered that mistakes definitely occur in architecture, 8.3% answered that mistakes very rarely occur, 1.7% think that mistakes never occur in architecture, and 1.7% of the questioners do not know, as shown in **Fig 1**.

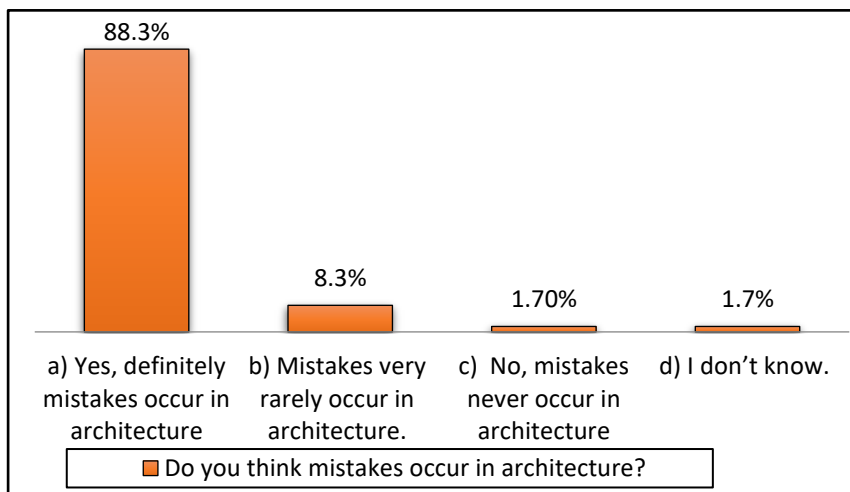


Figure1. Chart showing the ratio of questioners' opinion about occurring mistakes in architecture (**Prepared: Researchers**).

In another question about the main reasons for making architectural mistakes in buildings in Al Sulaymaniyah city, the opinion ratios of the questioners were: 43.3% (Inexistence of good experience and not being expert in the design process), 33.3% (Not taking responsibility for the design process), 68.3% (Inexistence of suitable laws (rules) from the municipality and other related sides), 65% (Different scope of practice in the design process), 6.7% (Economic factor) and 35% (The executing process). Here it indicates that according to the asked architects, the most effective reason for making mistakes in the building are; inexistence of suitable laws that lead designers to make mistakes in buildings, then different scopes of practice as there are other specialists that work in architectural fields, then inexistence of good experience also leads to making architectural mistakes and then other factors.



In another question regarding the designers' most dangerous points in making mistakes in architecture, the answers are as shown in **Table 3**.

Table 3. The ratio of questioners' opinion regarding the most dangerous point of designers in making mistakes in architecture (**Prepared: Researchers**).

Dangerous points about making mistakes in architecture	Not Dangerous (%)	Little Dangerous (%)	Medium Dangerous (%)	Very Dangerous (%)
a) Letting less experienced (inexperienced) designers to design alone.	1.7	1.7	31.6	65
b) Neglecting simple mistakes during the design process.	0	18.3	56.7	25
c) Neglecting laws and guidelines of the municipality during the design process.	3.3	16.7	41.7	38.3
d) Imitating and copying designs for different projects.	1.7	10	26.7	61.6
e) Building execution without consulting the designers.	0	1.7	38.3	60
f) Using buildings for different functional use of the designed object.	0	15	25	60

Here the result indicates that it is very dangerous to let less experienced (inexperienced) designers design alone since the inexperience reason affects the design process and leads designers to make mistakes. Applying this result on the research hypotheses proves the second hypothesis stating that, "Experience in the design process has an important role in avoiding the propagation of mistakes in the contemporary architectural design".

Then imitations and copying designs for different projects are very dangerous in making mistakes; applying this result on the research hypotheses proves the third hypothesis of the research stating that, "The uncontrolled imitation in design would result in the propagation and increasing of mistakes in contemporary architectural design". After that, executing buildings without consulting the architectural designer and using the building for different functional use of the designed object have the same degree of danger, then neglecting simple mistakes during the design process have medium danger and finally neglecting laws and guidelines of the municipality is dangerous.

- C: Axis of Reducing and Controlling Architectural Mistakes:

In a general question about the ability to control mistakes in architecture, the results were: 71.6% think that all mistakes can be controlled, 21.7% think that some mistakes can be controlled, 5% think that mistakes cannot be controlled, and 1.7% of the questioners do not know the answer of this question. This shows that according to the asked architects, all mistakes in architecture can be controlled, while there is a small ratio believing that mistakes in architecture cannot be controlled. In another question about the best method to reduce making mistakes in architecture, the results were:

81.7% answered (Detail checking of designs before execution) has big effect, 66.6% answered (Avoid using buildings for different functional use of the designed object) has big effect, 65% answered (Less experienced designers design in corporation (In team) with good experienced designers) has big effect, 56.7% answered (Avoiding the imitation process (copying) of designs for different projects) has big effect, 33.3% answered (Only good experienced designers should



be allowed to design) has big effect and 30% answered (Only international firms should be allowed to design) has big effect.

The results indicate that according to the asked architects, the best method to reduce making mistakes can be summarized as the following points:

1. Detailed checking process for architectural drawings before execution. This could be done through an academic and independent professional staff to check drawings to eliminate architectural mistakes.
2. Avoiding the use of buildings for different functional use of the designed object.
3. Encouraging less experienced designers to work in a team with the well experienced designers who are more expert in the design process is another method.
4. Avoiding imitation and copying designs for different projects.
5. Controlling simple mistakes during design process.

" Mistakes that occur in architectural projects that have been confirmed and authenticated by Governmental related parties, as illustrated in **Figure 2**, have great effects of becoming acceptable in the concept, idea and general culture of the society and even architects to repeat and propagate", as illustrated in **Table 4**.

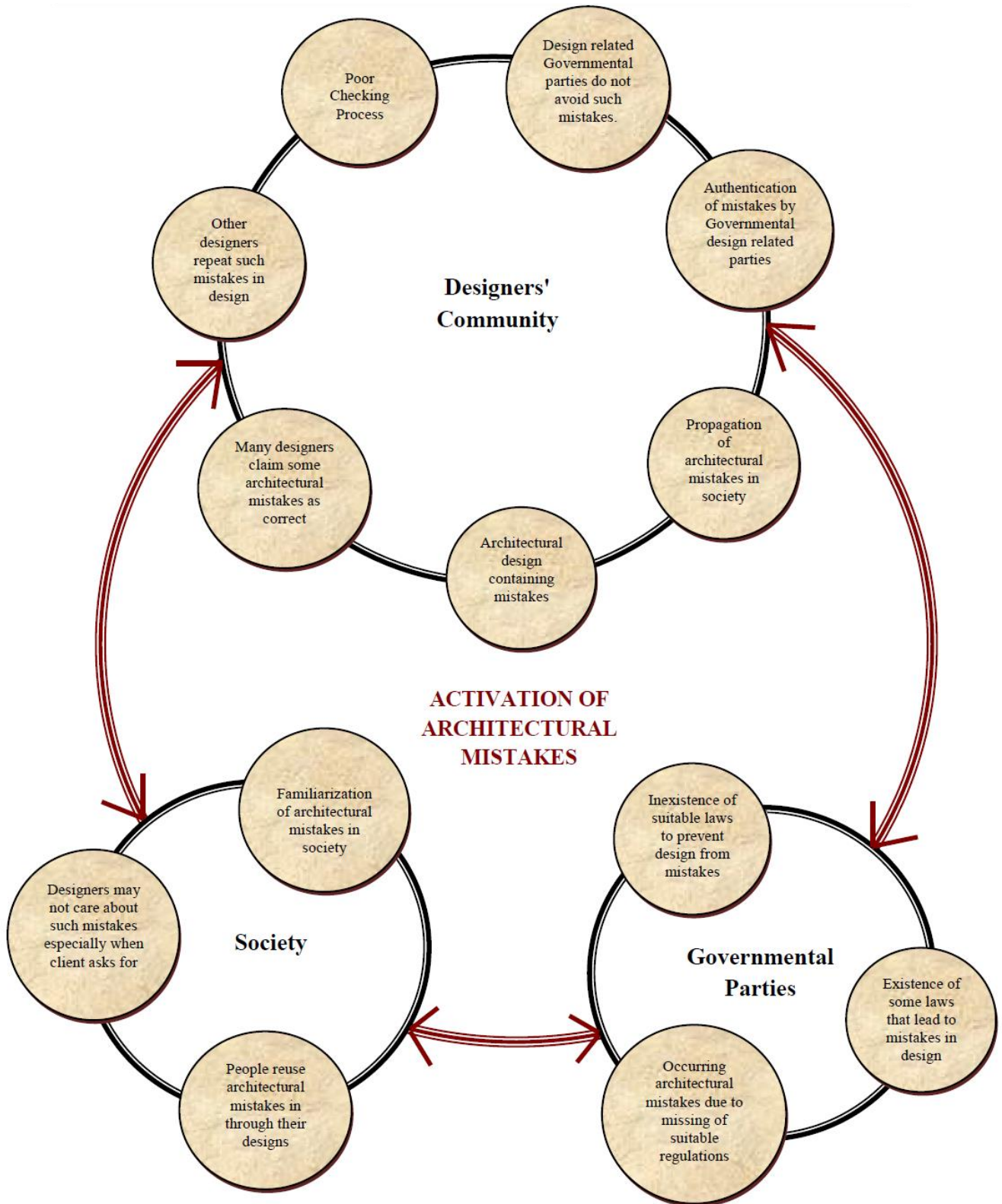


Figure 2. The loop of making Architectural mistakes between designers, people, and governmental design related parties and activation of mistakes in society (**Prepared: Researchers**).



Table 4. The ratio of questioners' opinion about the best methods and the type of their effects to reduce making mistakes in architecture (**Prepared: Researchers**).

In your opinion, what is the best method to reduce making mistakes in architecture?				
Methods to reduce making mistakes in architecture	Has no effect (%)	Has little effect (%)	Has a medium effect (%)	Has a big effect (%)
a) Only international firms should be allowed to design.	35	28.3	30	6.7
b) Less experienced designers design in a corporation (In a team) with well-experienced designers.	0	8.3	26.7	65
c) Only good experienced designers should be allowed to design.	20	33.3	33.3	13.4
d) Controlling simple mistakes during the design process.	1.7	15	38.3	45
e) Avoiding the imitation process (copying) of designs for different projects.	3.3	10	30	56.7
f) Avoid using buildings for different functional use of the designed object.	0	13.4	20	66.6
g) Detail checking of designs before execution.	0	3.3	15	81.7

According to the asked architects, there are some methods to reduce making mistakes in architecture from the results of the above question. Applying this result on the research hypotheses, it proves the fourth hypothesis of the research stating that, "There are methods to control making mistakes and propagation of mistakes in architecture".

- D: Axis of the possible degree of the architectural designer to make a mistake in architectural design values for the design of housing (Residential) buildings:

This axis is related to making mistakes in architectural design values. The questionnaire forms contain only one question. The forms were delivered to architects working in the academic field because architects that are working in an academic field may know much more about the nature of architectural design values and their importance in the design process than other architects.

"The question is on the possible degree of architectural designers to make mistakes in architectural design values for the design of housing (Residential) buildings".

Only physical values were selected in the questionnaire, as mentioned in the second and the third chapters. At the same time, the questioners are asked to re-arrange the architectural design values according to their importance degree in the design process for the residential buildings. The results are illustrated in **Table 5**.



Table 5. The ratio of questioners' opinion about the possible degree of architectural designers to make mistakes in architectural design values (**Prepared: Researchers**).

Possibility of making mistake	No possibility of making a mistake (%)	The rare possibility of making a mistake (%)	Medium possibility of making a mistake (%)	High possibility of making a mistake (%)
Architectural Design Values				
Functional design value.	0	30	20	50
The standard use design value.	5	20	30	45
Material honesty design value.	0	20	50	30
Social design value.	0	45	50	5
Structural design value.	5	30	60	5
Green and sustainability design value.	0	10	35	55
Environment design value.	0	5	30	65
The health design value.	5	20	40	35
The economic design value.	15	20	15	50
Religion design value.	20	35	45	0
Legislation design value	15	30	30	25
Traditional design values.	10	30	25	35
Gender-based design values.	5	30	25	40

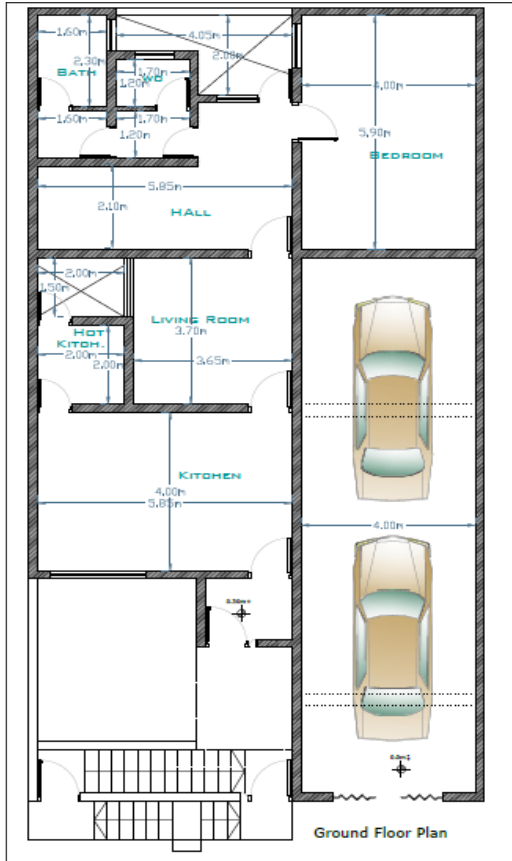
Second Stage: Graphical Analysis:

This stage includes a graphical analysis of selected buildings in Al Sulaymaniyah city to show and analyze architectural mistakes compared to the correct cases according to architectural fundamentals and standards.

To make a limit for the research in the second stage of the case study, the study takes architectural mistake only in one type of building which is (Residential buildings) during the period of (2000-2010) as in this period new housing projects were designed and constructed by both investment and noninvestment decisions. The reasons for selecting this type of building are;

- To control the size of the case study in number; (if all kinds of buildings are taken, a large number of buildings have to be taken in the graphical analysis, which would make the case study so big)
- Residential buildings are those types of architecture that everybody uses mostly in daily life more than other types and are more in number than other buildings.

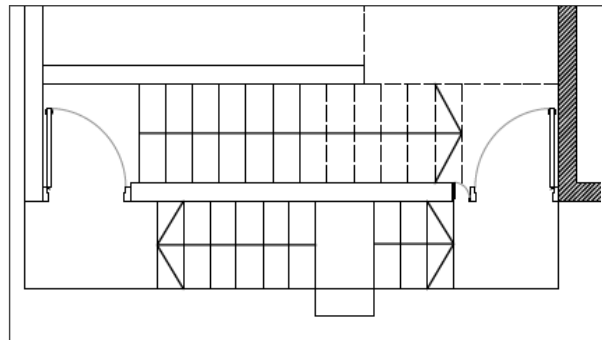
Regarding an appropriate statistical ratio for selected buildings, residential units are selected in 25 neighborhoods out of 108 neighborhoods. Fifty horizontal housing units, 140 vertical housing units, and 20 mixed-used residential units are selected. **Figures (3-7)** show only some of the graphically analyzed architectural samples containing architectural mistakes when compared to standard cases in Neufert standard.



A: Ground floor plan; Existence of two stairs with a common space between them where the space is 50cm.



B: Front view of the house



C: Architectural mistake: Enlarged plan of the stairs where the common distance between the stairs is 50 cm where a person holding a bag needs 80cm as the minimum space requirement according to Neufert.. (Researchers)

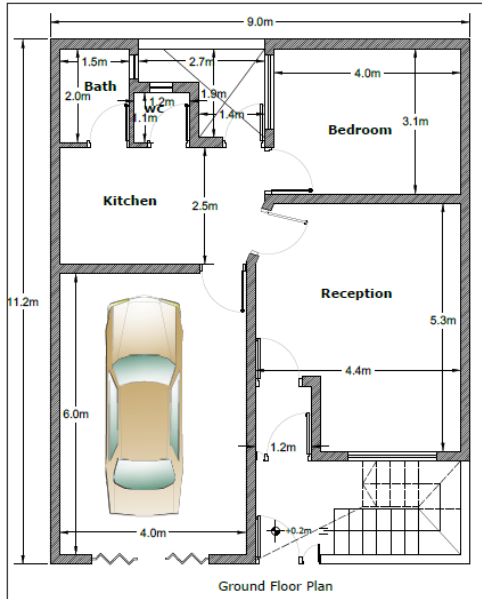


D: View of the two external stairs with a common space between them where the space is 50cm and taking the outdoor walk way (Prepared: Researcher)

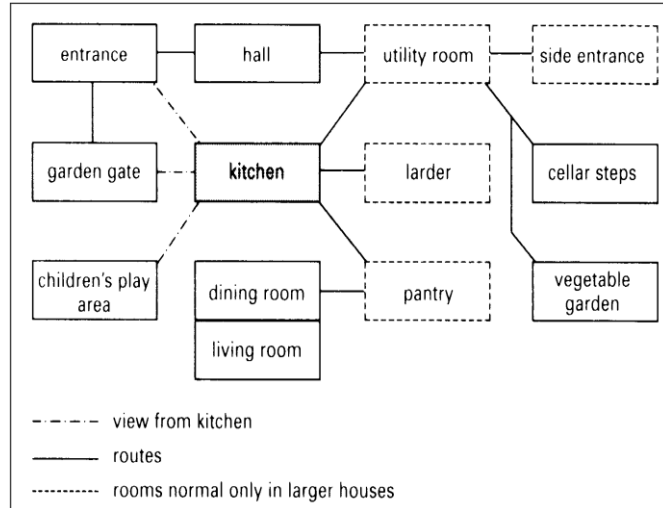


E: Standard human dimension and space requirements. (Neufert, 2001)

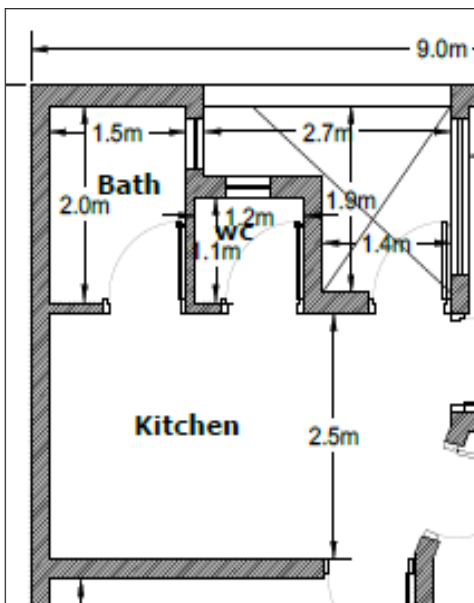
Figure.3. First sample of the horizontal residential building designed in 2008 in Sulaymaniyah city, showing architectural mistakes done in the building's design. The comparison of the mistake is made according to the standard case in Neufert Standard (Prepared: Researchers).



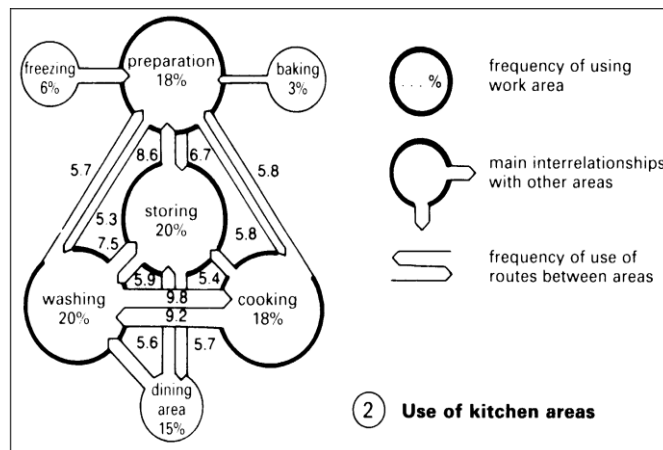
A: Ground floor plan showing wrong functional relationship in a house.



B: Relationship between kitchen and other parts of house. Kitchen is primarily a workplace in house where the householder may spend long time, so careful design is very important. (Neufert, 2001)

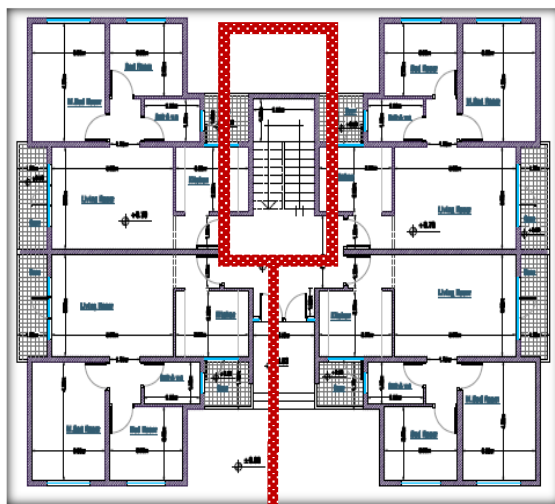


C: Architectural mistake: Enlarged plan showing kitchen in a wrong place inside the house where bath and WC have no privacy opened on the kitchen besides the small area of the kitchen with unhealthy property. (Prepared: Researcher)

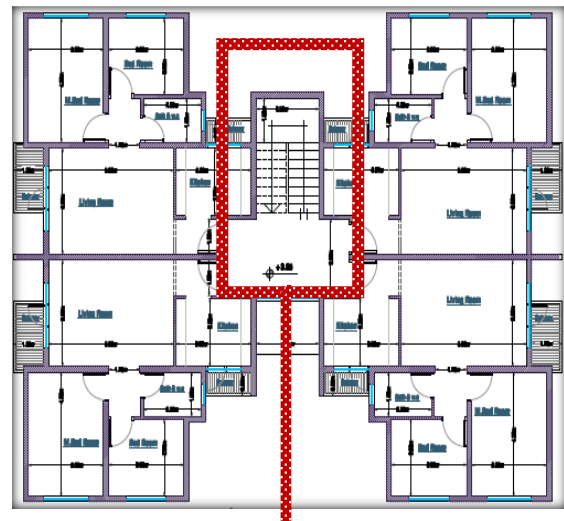


D: Diagram showing the importance of uses and circulation between kitchen and other related areas. (Neufert, 2001)

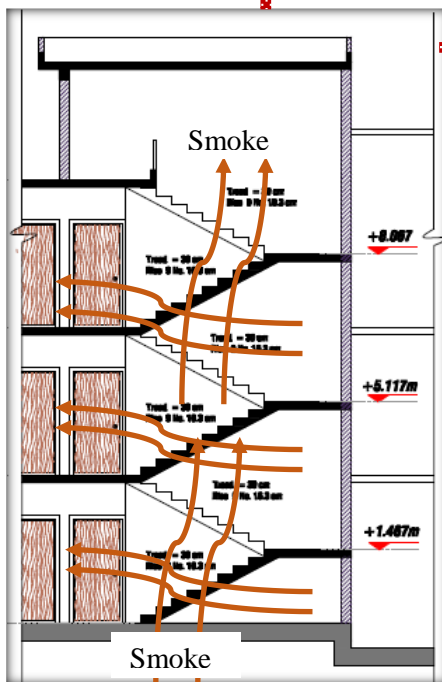
Figure 4. A selected sample of the horizontal residential building was designed in 2010 in Sulaymaniyah city, showing architectural mistakes done in the building's functional design. The comparison of the mistake is made according to the standard case in Neufert Standard (Prepared: Researchers).



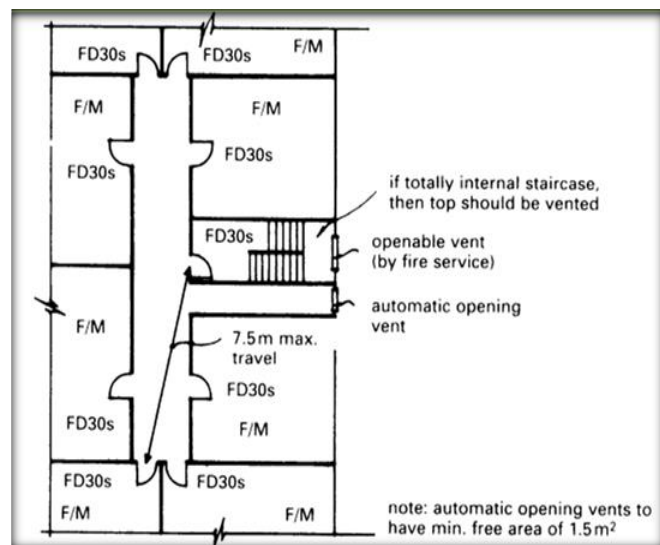
A: Ground floor plan containing four apartments in each floor



B: Typical floor plan showing the location of the open staircase and each apartment entrance privacy condition.



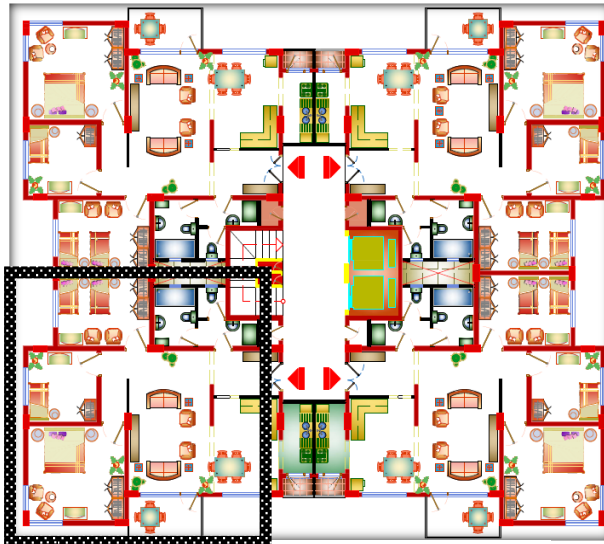
C: Architectural mistakes
 - Using a non-protected and opened up staircase in vertical housing.
 - Inexistence of fire escape.



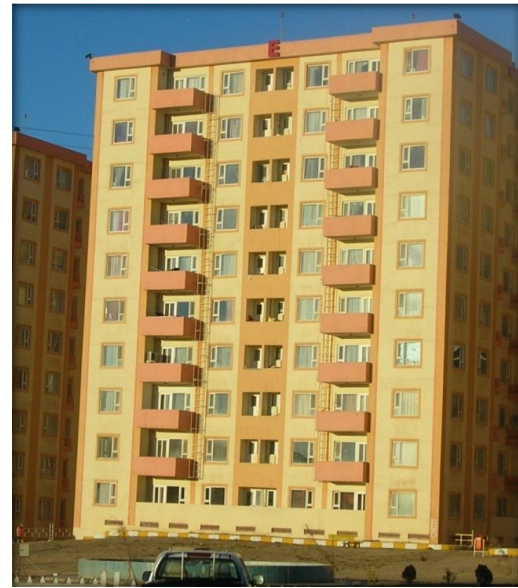
D: Correct Case

Housing units of three and more storeys or according to the UK Building Regulations with one or more floors over 4.5 m above the ground require a protected stair way of 30 min fire-resistant construction, furnished with self-closing fire doors. (Neufert, 2001)

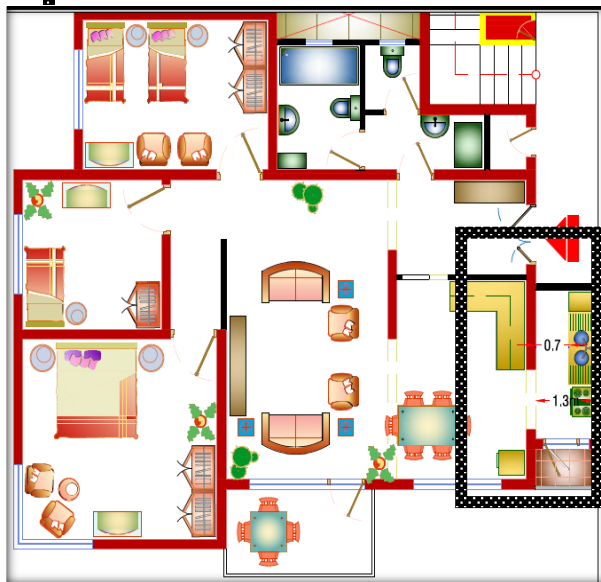
Figure 5. A selected sample of the residential building is a vertical housing apartment in the Kurd city project designed in 2009 in Sulaymaniyah city, showing architectural mistakes done in the building's functional design, such as the inexistence of fire escape inexistence of privacy for residential units in each floor. The comparison of the mistake is made according to the standard case in Neufert standard (Prepared: Researchers).



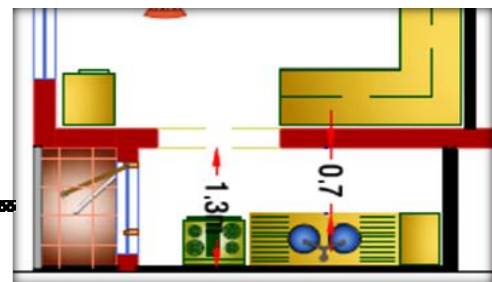
A: typical floors plan showing open stair case without fire escape.



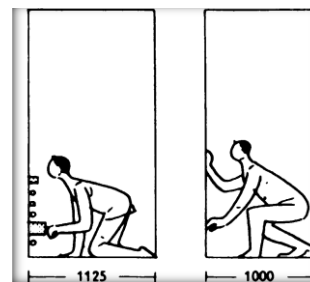
B: Adding a metallic ladder after two years of accommodation for the purpose of fire escape, the designer company added as a solution. This is a confession of the mistake where fixed ladders are not acceptable (Neufert, 2001).



C: Typical flat plan 110m2 showing architectural mistakes made by architects.

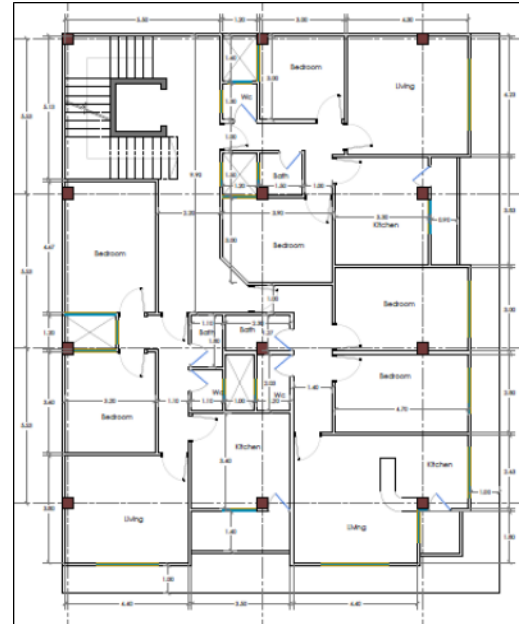


D: Architectural mistake: Distance between wall and counter-sink is less than 70cm; less than standard distance.

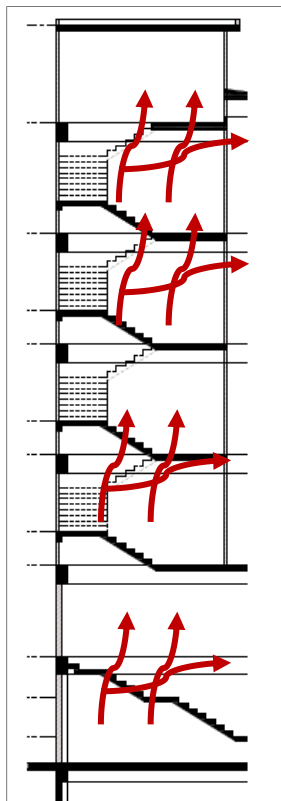


E: Minimum human dimensions and space requirements in kitchen. (Neufert, 2001)

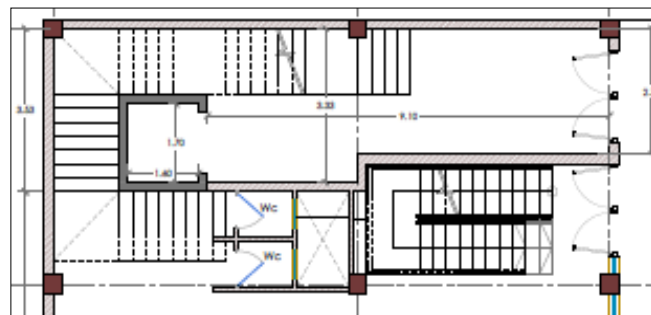
Figure 6. A selected sample of the residential building is a vertical housing apartment in the German Village project designed in 2009 in Sulaymaniyah city, showing architectural mistakes done in the building's functional design, such as the inexistence of fire escape mistakes in the function and space requirements in each apartment. The comparison of the mistake is made according to the standard case in Neufert standard (**Prepare: Researchers**).



A: Enlarged plan of a flat containing architectural mistakes: 1- putting 10 m long, dark and unventilated corridor. 2- Kitchen with dimension (2x2.6) m containing a door on balcony is very small to take its furniture with circulation.



C: Section through vertical circulation shows the opened up and unprotected stair and cannot be used as fire escape route.



B: Enlarged plan of mezzanine floor showing Architectural mistakes:
 1- Mistake in vertical circulation since this stair is special to residential part but it's blocked in the mezzanine floor so people can use only elevator to go upstairs or the stair can be used from the first floor.
 2- Taking columns at a side of stair that reduces the width of the stair since 20cm of the width of the stair cannot be used as there is a beam above it.
 3- Dividing landings in two triangular steps especially if the numbers of steps are too much. (Neufert, 2001)

Figure 7. Mixed used residential building on Qazi Muhammad Street, composed of five floors, is used for commercial purposes and residential flats. It was designed in 2010. The figures show architectural mistakes in the building's functional design, such as the inexistence of a fire escape and mistakes in each apartment's function and space requirements. The comparison of the mistake is made according to the standard case in Neufert standard. (Prepared: Researchers).

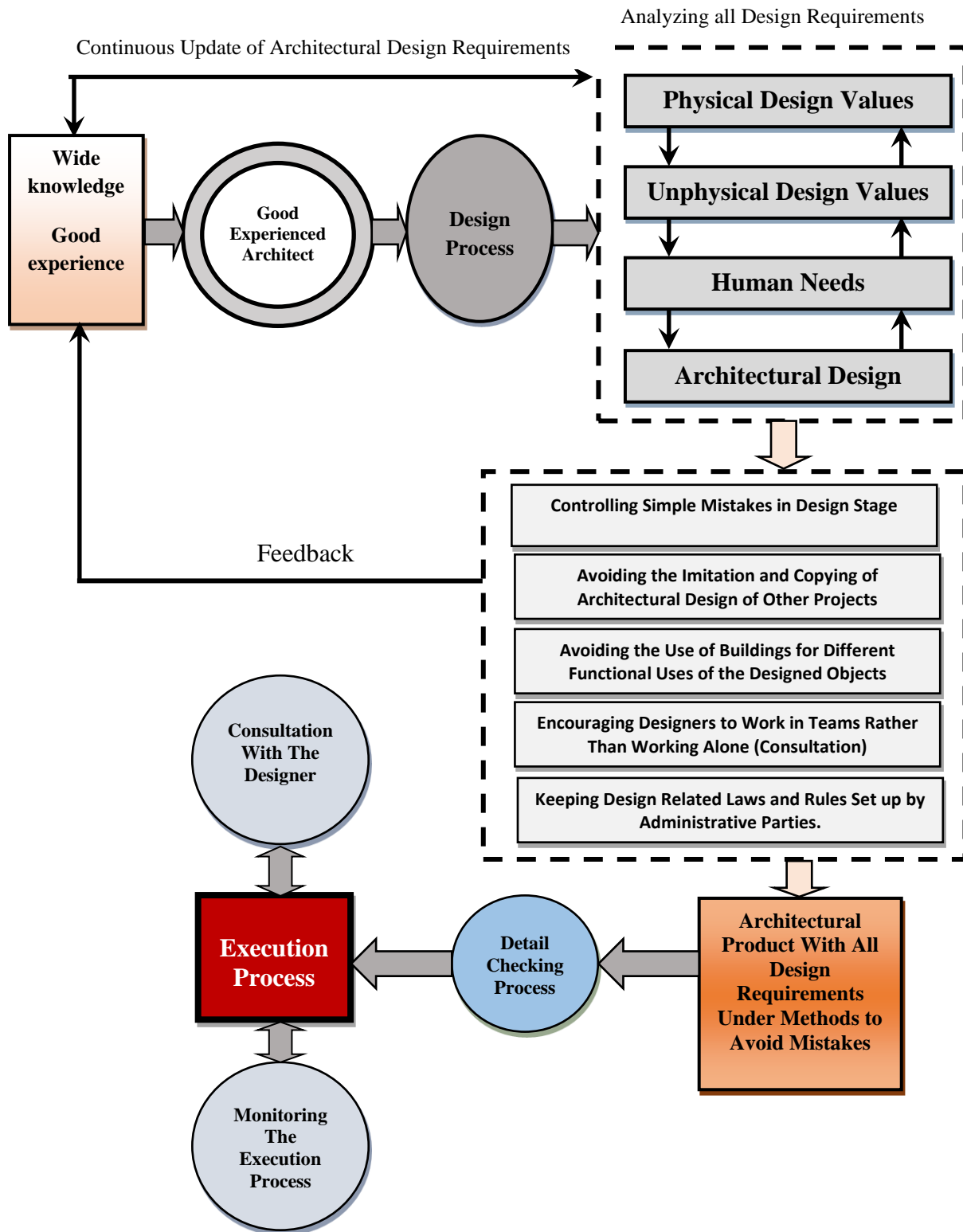


Figure 8. Conceptual Diagram showing the procedure of the design process with the least probability of occurring architectural mistakes. (Prepared: Researchers).



3. CONCLUSIONS

1. The architectural design process is a complicated process; designers need careful attention along the stages of the design process. The architectural design process includes some important values; such values must be considered during the design process.
2. Experience forms and integrates designers' knowledge since there is an important position of experience in the design process; designers need to have good experience to predict problems and find the best solutions to succeed in the process.
3. Most of the buildings' diminutions in Al Sulaymaniyah city are related to the architectural design and execution process as there is a relationship between design and execution processes. When the execution process is not very accurate and is not according to the design process, there would be diminutions in the architectural product.
4. About mistakes accruing in architecture, most architects believe that mistakes definitely occur in architecture, and they believe that architects sometimes make mistakes in architectural design. The best way to reduce mistakes in the architecture design process is illustrated in a diagram of strategic processes shown in **Figure 8**.
5. In the indications of mistakes in architecture, three main parties are the main reasons for making mistakes in architecture: designers, executors, and clients. These three parties are making mistakes in architecture. Still, designers are the most responsible party for making mistakes in architecture because designers know more about the nature of architecture mistakes than other parties. Architects have to reference true knowledge (correct solutions) in the design process so that other parties depend on them.
6. Inexistence of suitable rules (laws) that prevent architectural mistakes or the existence of some rules that lead to making mistakes in architectural design and authentication of such mistakes by design related governmental parties are the main reasons for making and propagating mistakes in architecture.
7. Mistakes that occur in architectural projects that have been confirmed and authenticated by Governmental related parties have great effects on becoming acceptable in the concept, idea, and general culture of the society and even architects to repeat and propagate.
8. Governmental institutions such as (The Engineering Union Syndicates, Directorate of Municipalities) have a great role in propagating mistakes in architecture. Such institutions give authentication to the architectural projects; therefore, architectural mistakes could be controlled under such institutions' checking process or could be propagated in the case of neglecting mistakes.

4. RECOMMENDATIONS:

1. Taking architectural design values to the design process's points of view, the study recommends architectural designers to study all the design values completely before starting the design process.
2. The study encourages young architects who have limited experience in the design process to work in teams with well-experienced architects to learn from their design process experiences.
3. Formation of an academic and independent scholar staff to check all architectural designs and drawings before the execution process to eliminate architectural mistakes and to avoid the propagation of mistakes.
4. Establishing an architectural institute to set up important and trusted rules for the design process and all other issued related to architecture like international institutes of (AIA, ISO, IEC, etc.)

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