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Paper **Shape Reconstruction**
Study of alternative typologies of shaps



Topic: Architecture

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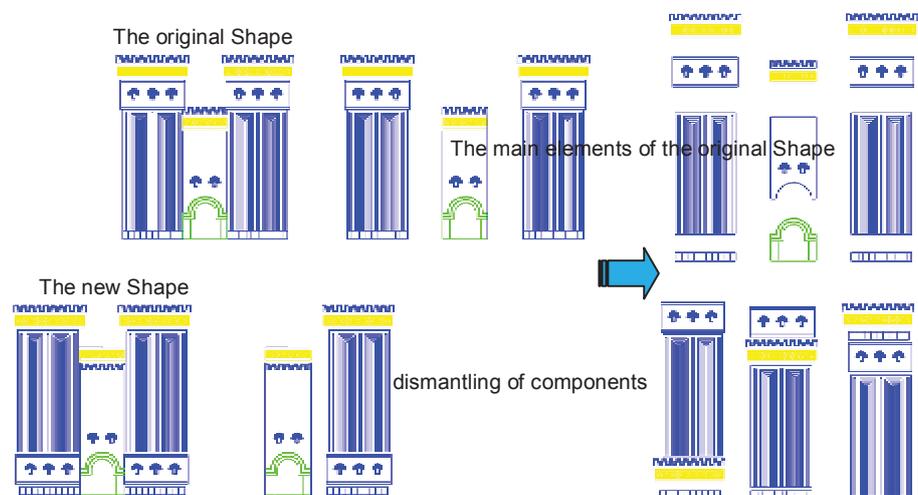
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Abstract:

All buildings are characterized by possessing a set of architectural elements and details that are most important in giving the characteristic of the architecture as a style, where these details and architectural elements have configurations structurally different and this difference in structuralism distinguishes the form of another where any architectural configuration is characterized whether to indicate functional aspects or aesthetic formal aspects that has privet and special style which is consistent with the geographical or historical background to this style. This study will focus on one of the architectural configurations of the gates, by testing a sample of these architectural configurations from different time periods such as Assyrian style gate, Romanian style gate and Babylonian style gate ... Etc. as a sample for analyses. This study consist of three stages, the first one is the theoretical framework for analysis and the formation of gates in general, the second stage is a test of the sample of gates by analyzing and dismantling of components to the basic elements of form and then encoded in digital form and make it a matrix , finally the last stage .It is the process of restructuring elements (Re-forming elements) by using the probabilities of the matrix to produce new patterns which has structural properties similar to the original elements.



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Shape reconstruction

(A structural study of the architectural element as a single entity to find design alternatives)

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Abstract

All buildings are characterized by possessing a set of architectural elements and details that are most important in giving the characteristic of the architecture as a style, where these details and architectural elements have configurations structurally different and this difference in structuralism distinguishes the form of another where any architectural configuration is characterized whether to indicate functional aspects or aesthetic formal aspects that has privet and special style which is consistent with the geographical or historical background to this style. This study will focus on one of the architectural configurations that have a great variety of elements and architectural details like gates as a case study, by testing a sample of these architectural configurations (gates) from different time periods such as Assyrian style gate, Romanian style gate and Babylonian style gate ... Etc. as a sample for analyses. This study consist of three stages, the first one is the theoretical framework for analysis and the formation of gates in general, the second stage is a test of the sample of gates by analyzing and dismantling of components to the basic elements of form and then encoded in digital form and make it a matrix , finally the last stage .It is the process of restructuring elements (Re-forming elements) by using the probabilities of the matrix to produce new patterns which has structural properties similar to the original elements.

1. Introduction

The architectural legacy of the various civilizations is considered an important factor which left its features on the shape of buildings, historical and archaeological cities all over the world. These cities are still examples for the originality and architectural identity of a certain city or region; such as Babylon, Khursibad and Hatra in Iraq and Rome in Italy. So, designers must make use of this heritage in away that fulfill the aesthetic function of the architectural work and

achieves a privacy that is connected with the architectural legacy of any area in order to reveal the historical depth of that architectural work.

In this research, focus will be on the simulation of the nature, which is dealing with the geometrical shapes and disassembling them into their primary elements and then reconstructing these elements relying on the same disassembling mechanism for the primary shape in a way which preserves the same spirit and influence of the original shape which is considered a reference for the new shape.

2. Statement of the problem

There are many cities in the world have historically models reflect the architectural authenticity and identity even some city named according to the name of important historical landmark in it, like Mosul city (Alhadba city) in Iraq where the name of the city (Alhadba) come from minaret at important mosque in the same city as well as Hamburg city in Germany where it took its name from the first building was found in that region.

At present, and according to the globalization many architectural design directions appeared which led at times to efface the identity of historical and architectural characteristics of this type of cities therefore we need to find mechanize that help the architects and designer to create new shape compatible with the original shape or style.

From all the above the problem of the research evolves out of:

1. Non-clarity of the mechanism adopted in disassembling and reconstructing the shape to obtain new forms compatible with original shape
2. The limited use of algebraic mathematical formation as a one of shape grammar techniques in the mechanism of the design new shapes.
3. Research about shape reconstruction abounds, but the study algebraic mathematical formation to find design alternatives are scarce.

3. The Purpose of the study

The research aims to find mechanism in disassembling and reconstructing the shape to obtain new forms attuned with the original shape and style , the models which is created can be used as details or part shape to design new buildings.

4. Objective of the research

The objectives of the research are:

1. To understand the mechanism of disassembling and reconstructing the shape
2. To identify the factors which contribute to a create new shape with well-matched with the original shape.
3. To find a matrix of shapes, through which several model that can be designed depending on one shape.

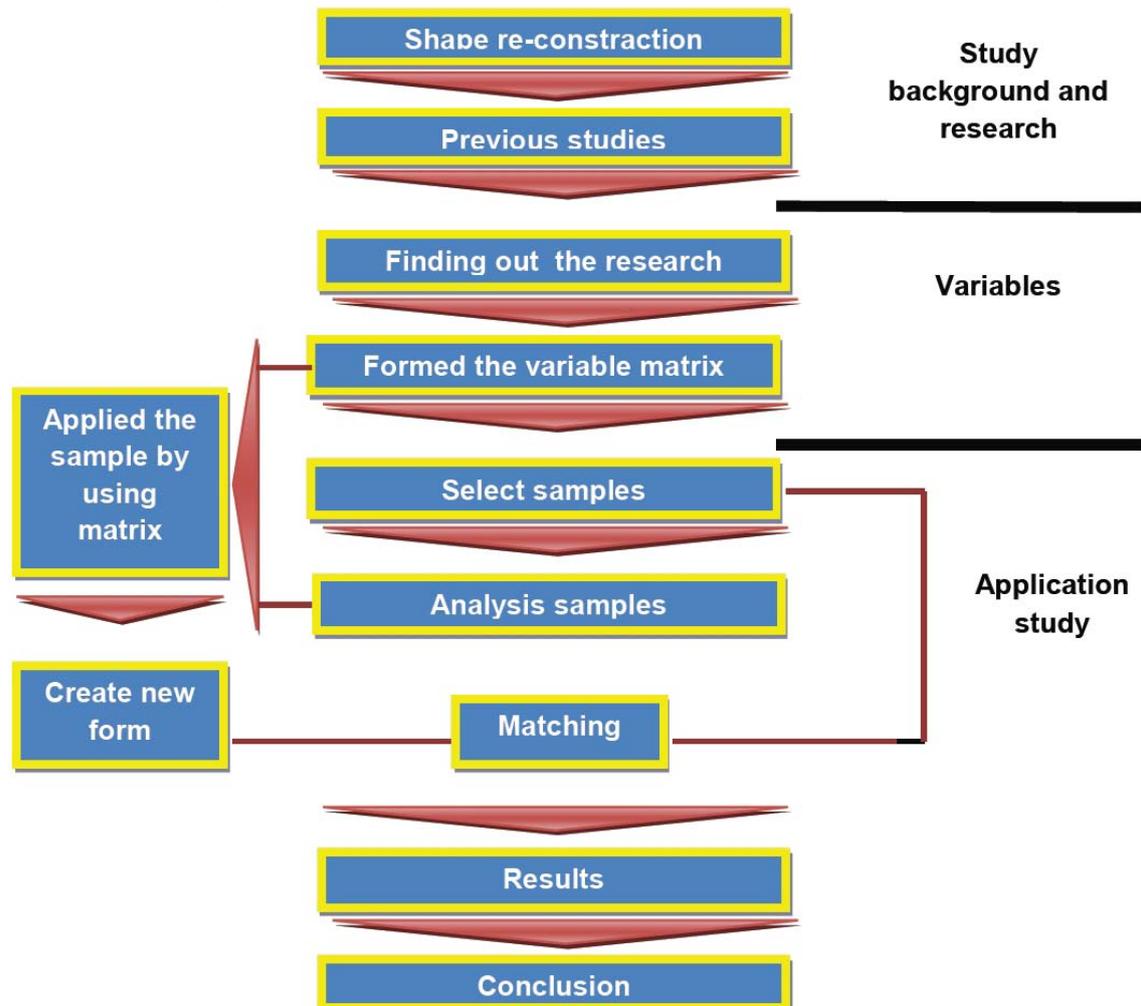
4.To analyse the effects of using matrix to create a new shape compatible with the original shape.

5. Hypothesis of the research

The hypothesis of the research was employed represented by the possibility of design depending on the mechanism of construction and disassembling to find new models and thus reaching the objective of the research.

6. Previous studies

Several studies indicated the importance of studying shape disassembling into its original constructional elements, as it is easy for the designer to use these elements to construct new shapes that belong to the same generation. And this is considered one of the shape construction methods. The work in this research was divided into three parts and as shown in the structure of the research:



Le Corbusier, in his philosophy of design [1], mentioned that there are three techniques for the architectural design process. They are:

1- The technique of utility buildings: The building is considered successful if it

performed its function perfectly, just in the case of a machine. So the building is considered successful if it functions well. For example, the house for him was merely a place (machine) for living [1].

- 2- The common architecture mode: This idea is derived from the duplex idea, which was derived from the Islamic architecture in the middle ages (as Charles Edward says).
- 3- Contrast with the nature: That is done through the tendency to the human-made geometrical shapes and making use of them in the process of design[1].

Moreover, some studies indicated that the mechanism of the geometrical shape formation is done in accordance with a mathematical equation of formation and that is accomplished through the use of some algebraic methods for analyzing images, as shown by Xiu Wu Huang in his research entitled:[2] where the mechanism of constructing and disassembling the shape is similar to a mathematical equation.

In accordance with the algebraic analysis of images, any shape carries a code or a mathematical equation that stands for it,[2] and when changing the values or the elements of this equation, then we have a different shape.

For example:

$$5 = 3 + 2 \dots\dots\dots (1)$$

where the reconstruction of several equations from this becomes:

$$5 = 3 + 2 \dots\dots\dots \text{(the original equation)}$$

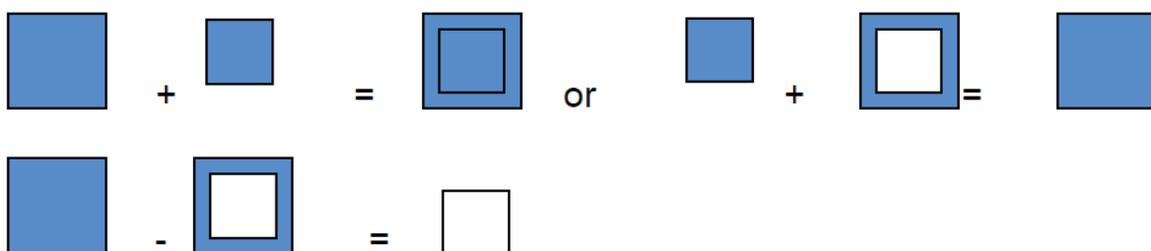
$$5 - 2 = 3 \dots\dots\dots (1)$$

$$3 - 5 = 2 \dots\dots\dots (2)$$

But when using another relationship or other numbers to find the same solution, then this means another design and as the following:

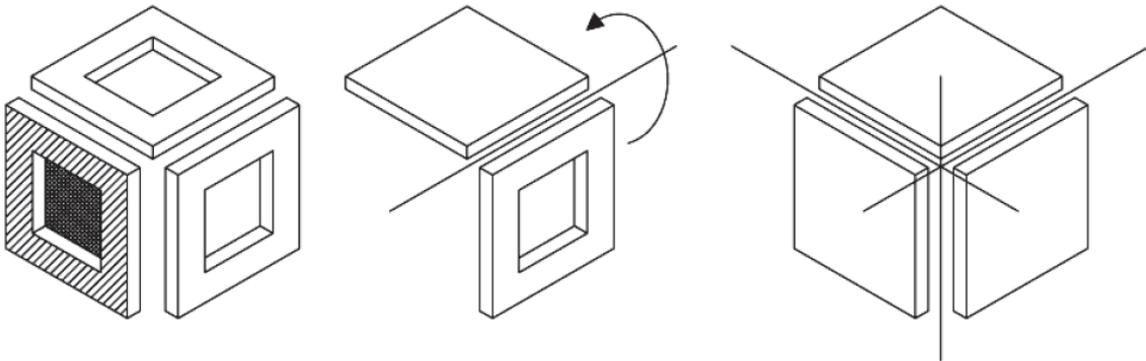
$$5 = 1 + 1 + 3$$

An example for that, in terms of formation (Figure-1):[researcher]



(Figure-1) the element of equation shape .[researcher]

But study [3], indicated the formalistic configurations as a relation between one shape with another shape and the relationship of the shape with the whole, and as follows(Figure -2):



(Figure-2) the relation among parts shape to create the compact form.[researcher]

Another study [4] indicated that the architectural formation is similar to the language sentences as there is a relationship between a letter and another to form a word, and a relationship between a word and another to form a term,[5] and several words and terms to form a meaningful sentence and relations can be altered but giving the same meaning.

7. Conclusion from previous studies and discovering the problem

Previous studies focused on the method of disassembling and reconstructing the shape in general. So, some variables – from the previous studies - were identified and a theoretical framework was built up, just as will be shown in the consequent part of the research. After reviewing the previous studies the research problem emerged, which is represented by (the small number of studies which identified the main items of the production process in order to produce design alternative which are related to a formal reference). Based on that, the objective of the study was identified: (finding a mechanism to produce design alternative that depend on a formal reference and the relationships of this reference). For the purpose of making the study more objective the relevant research variables were included in a matrix in order to produce the alternatives, as in the case in the beginning of the research.

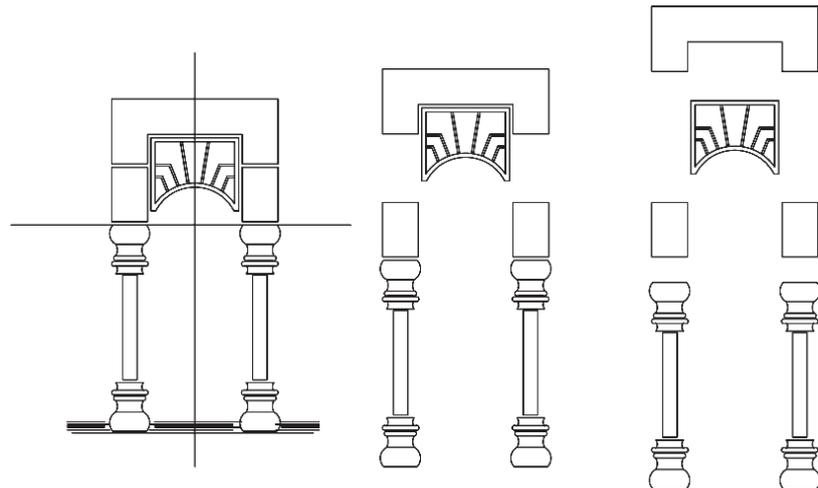
8.The items of the research

After reviewing the previous studies focus will be on several items related to the methodology of the research and that can be made use of in the practical study in order to apply the matrix, and as follows:

8.1 Disassembling the shape

- A- Compound shape (main element).
- B- Secondary shape (secondary element)
- C- Single shape (an element).

Any formation consists of three basic elements (main, secondary and single), where the basic shape represents the original formation[6]



(figure -3) Create form by using object and compact shape [researcher].

Element+element = Secondary shape or Secondary shape + element = main shape

The elements (from 1 to 10) and the secondary shapes (from A to Z) will be coded in order to be used easily in the matrix of shapes that will be designed to explore new alternatives which are identical or not identical to the original shape before analysis in terms of structural and architectural style relationships.

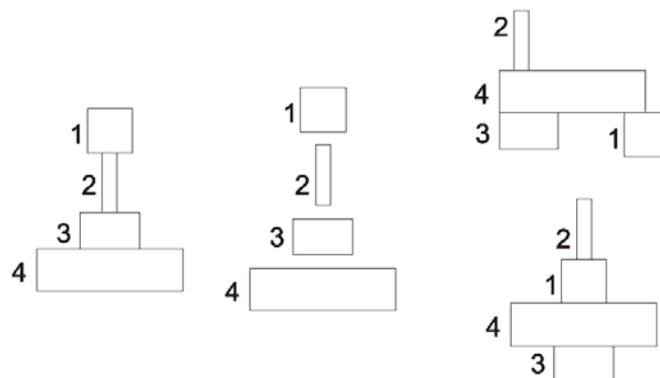
A shape may involve more than 10 elements and it can also include several secondary shapes, as the mechanism of the shape disassembling.

8.2- Relationships between shapes

Each architectural construct includes several geometrical relationships, through which styles and affiliations can be distinguished. And this study deals with shape morphology, correlations and topological sequence[7], as follows:

A- Sequential relationship:

In this case, elements overlap in the form of a connected series and as the following equation. And this series can be in two types[8]; horizontal and the vertical.



(figure -4) Create form by using object and compact shape .

B- Formational relationship:

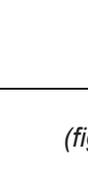
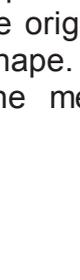
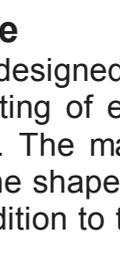
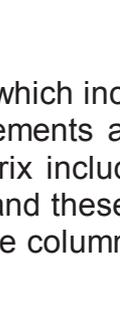
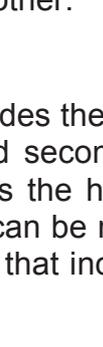
In this relationship, elements correlate with each other.

9. Making a matrix of the shape

In this phase, a matrix will be designed which includes the shapes potential to form the design alternatives, consisting of elements and secondary shapes which are derived from the original shape. The matrix includes the horizontal row which involves the individual elements of the shape and these can be numbered as shown in the first part of the research in addition to the columns that include the secondary elements .

When we multiply the matrix, we have more than one multiplication process in accordance with the shape we want to find,[6] where the first square of the column can be multiplied by the second square of the row and as follows:

An example for that is the following shape:

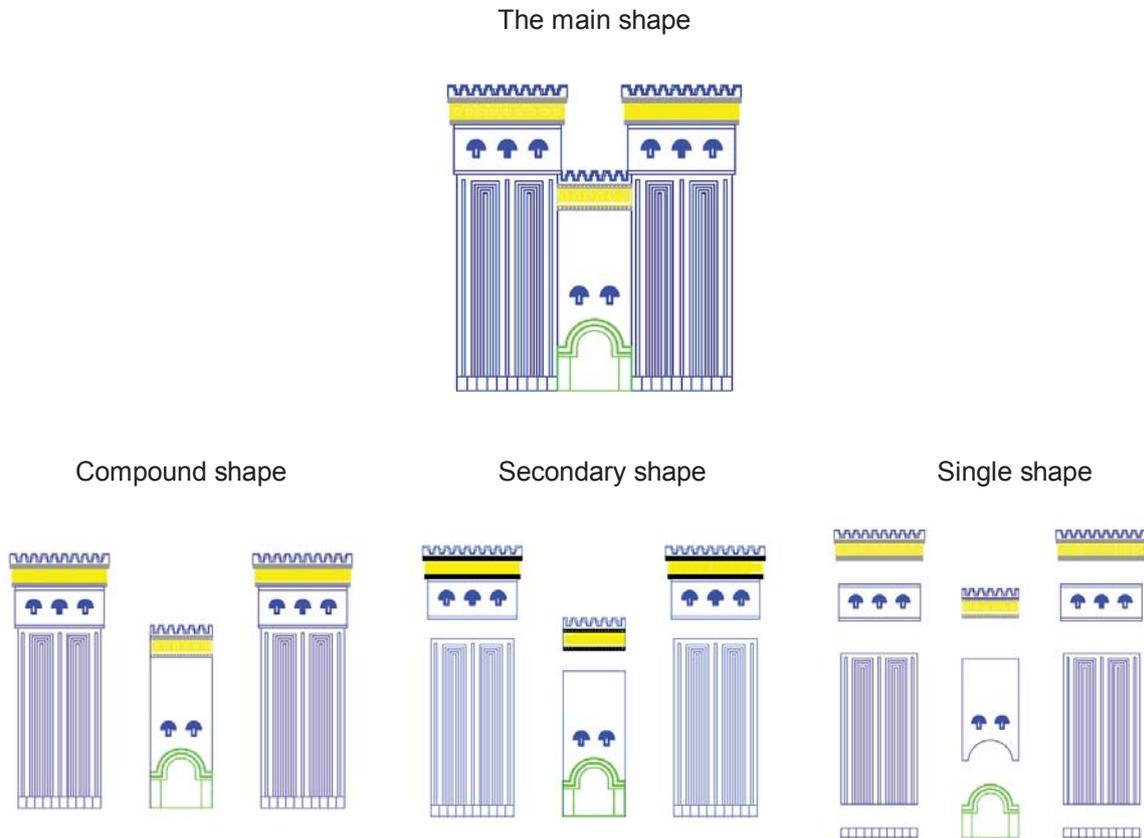
| Raw column |  |  |  |  |
|---|---|---|---|---|
|  | | | | |
|  | | | | |
|  | | | | |

(figure -5) Example of the matrix.

The multiplication process can be identified through the relations that have been mentioned in the first part of the research, so the resultant shape will not be very much different from the original one, because – in this example particularly – there is no rotation of the shape. The resultant shape depends on the determinants of the relationship and the mechanism of multiplication used to find design alternative.

10. The practical study

In this study the practical study consist of the mechanism of disassembling the original shape to three components: compound shape, secondary shape, and single shape as a figure below:



(figure -6) The disassembling of the main shape to three components.

11. Selecting the samples and applying the practical study

Historical gates were chosen and analyzed depending on the items submitted by the theoretical framework in the geometrical method using the computer program Auto Cad and applying the questionnaire form which was designed for the measurement process. These gates are:

1- Ishtar Gate.



(figure-7) Nirgal gate in Mosul City North of Iraq.

2- Khoursibad gate.

3- Hatr gate. The Sun City , Located to the west of Iraq and to the south-west of the city of Mosul, a distance of 110 km. And away from the ancient city of Ashur 71 km (figure-9).[9]



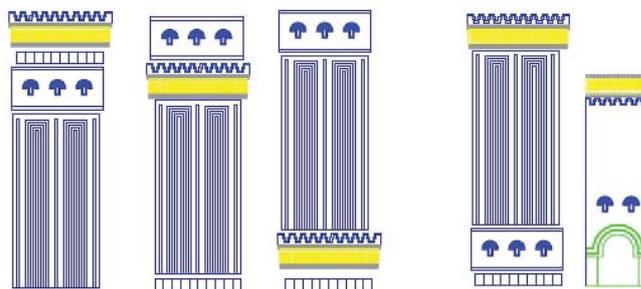
(figure -8) Hatr city , south Mosul City in Iraq.

4- Ashurian gate.

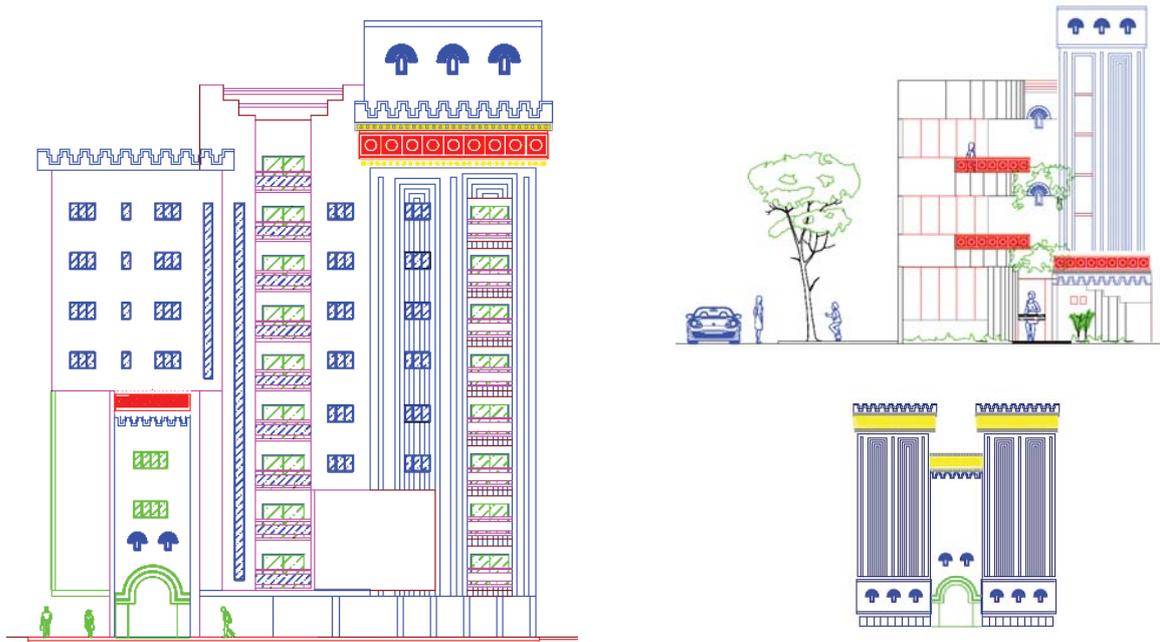


(figure-9) Nirgal gate in Mosul City North of Iraq.

Because the results of analysis were tremendous, one sample only was selected (Khoursibad gate) to be included within the research and as in the following shape:



(Figure -10) The design alternatives that resulted from the original shape



(Figure -11) Using of alternatives for design new project

12. Results of the practical study

After analyzing the gates and obtaining the elements and secondary shapes, a matrix was applied in order to find the design alternatives represented by either the design of a new gate with architectural style that is similar to the original shape but with different structural formation or architectural formations that might be used as detailed elements like doors or windows... etc. and as shown in table above.

After comparing the resultant shapes of gates with the original, it was found that the new gate accomplished 20% of structural congruence in terms of the style and 75% in terms of the architectural style, which included a group of secondary shapes included within the original shape. Also the sequential relations have a great importance in the congruence of the new shape with the original matrix and with a percentage of 77% and several statistical percentages concerning this study can be found, but the most important ratios is the congruence in the sequence of the elements.

13. Conclusions:

The type of gates is functional, formal and simple and it has many and diverse architectural elements due to the architectural styles. The results showed that the process of gate parts reconstruction depends on the design purpose of this process (gate, details, mass). the small percentage of the congruence is an evidence of using these alternatives was for designing a gate. For the higher ration of alternatives used as a elaborative elements or others due to the desire of the designer. And this way of finding the design alternatives that ensure that the design will be the same as desired.

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