

<p>Bisam Ehessan Alhafiz Oday q. Abduqader</p>	<p><i>Paper</i> Generating the engineering prototypes by using AutoLisp software</p>
	<p>Abstract The are many type of prototypes or ornament and deferent method to created it , the ornament are considered as one of the most important architectural elements on which several fields of design are depending on . These fields include (Architectural Design, Interior Design, Planning, Furniture Design, etc) . So it is important to study these element , their methods of composition, mechanisms and engineering characteristics in addition to the geometric relationships on which such engineering prototypes generation is depending on It's important to know that one of the important engineering properties generating a certain pattern are, center , type of branch , and repetition and in some time using size ,In addition, there are other properties including the possibility of repetition of the prototype total composition so as to form a coordinated fabric that ensures no distortion in the repetition .In other word, every part of these prototypes has its intimate connection with the other parts to constitute positive and negative parts as shown in figure below. In this study we will take the ornament that use Irregular shape in the start point of creating it .the selection ornament sample will be from important Italy (Roman-style) buildings . After finding these features, they can be used in designing a program using AUTOLISP language to create The Auto-generate program for making the ornament or prototypes with new compositions in fully automated way by just entering the data of a certain prototype. The basic shape, for example path line for leafs</p>
<p>Topic: Architecture Authors: Name1: Oday qussay alchalabi University of Mosul Collage of engineering Architectural dept. www.engineering-coll-mosul.com Name2: Bisam ehessan - University of Mosul Collage of engineering Architectural dept.</p> <p>References: [1] Robert J. Krawczyk ,(Creating Computational Architecture in AutoLISP), Princeton Architectural Press, 2009 [2] Danby , M.,(Grammar of Architecture Design), Oxford university press , London , England , 1963 . [3] S. J. Abas, Amer Shaker Salman(Symmetries of Islamic geometrical patterns) World Scientific express, 1995</p>	<ul style="list-style-type: none"> • Properties of organic shape , for example rotation with the determination of the rotation point of rotation and angle , path line repetition , and size • Repetition for example four times repetitions and the direction of such repetitions round a certain point, like the point of the center . <p>The number of repetition times of a certain prototype like four times per each prototype</p>  
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Paper title

Generating The Geometric Prototypes By Using AutoLisp Language
“Using Roman pattern to create new prototype”

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Abstract:

There are many types of patterns and different methods to create it. Patterns are considered as one of the most important architectural elements, on which several fields of design are depending on it . These fields include (Architectural Design, Interior Design, Planning, Furniture Design, etc). So it is important to study these elements , their methods of composition, mechanisms and geometric characteristics in addition to the geometric relationships that patterns generation depend on it. It is important to know that one of the important geometric properties for generating the certain pattern are center, path , type of branch or shape , repetition and in some times the scale using .There are other properties include the possibility of repeating the whole composition pattern to form the coordinated fabric which ensures no distortion in the repetition. In other word, every part of these prototypes have intimate connections with the other parts to constitute positive and negative parts. In this study we will apply the patterns using Irregular shape with path shape in the start point in its creation. Pattern samples will be selected from the important Italy (Roman- style) buildings .

After finding these features, we can use it in designing a program using AUTOLISP language to create The Auto-generate program for making the pattern or prototypes with new compositions in fully automated way by just entering the data of a certain prototype.(Figure 1 & 2)

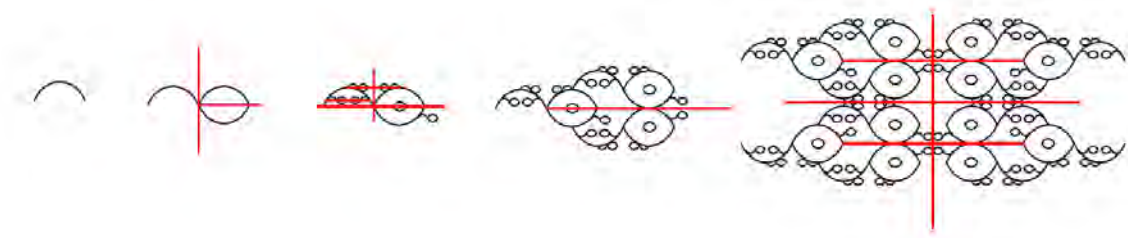
- The path of pattern .
- The basic shape, for example path line for leafs .
- Properties of organic shape , for example rotation with the determination of the rotation point of rotation and angle , path line repetition , and size.
- Repetition for example four times repetitions and the directions of such repetitions round a certain point, like the point of the center.
- Amount of repetition times of a certain prototype like four times per each Prototype.

1-Introduction:

Roman Architecture known by using many types of patterns and shapes which reflect the identity of its style, The plant patterns has been used ,which depict some of religious , life scenes and often used type of plants and leaves in the implementation of these patterns . In this part of study will identify what kinds of patterns? , how to generate it? and what the main shapes for these patterns and original shapes , after identified these types of patterns, will be placed on patterns that contain a horizontal direction or a vertical direction that is typically used to create form and also used at the bottom and top of the wall besides using it in the floor and furniture .



(Figure 1) The direction of path in the Roman patterns and ornaments . [1]



(Figure 2) The processing of re-construction of new shape model of Roman pattern
[By researcher]

2. What is the Roman Patterns

The Roman civilization classified as one of the rich civilizations and contain many types of patterns. The Roman architectural style compatible with nature through engravings, plants and geometrical patterns, and proportionality among all parts. Patterns give formality value for the architectural environment shape using it in Columns or buildings elevation. The most Roman patterns types are:

2.1. Botanical element:

Roman used most elements that used by the Greek Architecture, the most important of these are the Acanthus where the roman increase the number of his leaves and end rotate and also used another types of plants leaves like Ivy plant leaves, Grape leaves, Lotus leaves and Papyrus leaves and often make use of collars leaves, flowers and fruits which end by linking edges, also can contain thin strips. Sometimes adorned with images of human , animal or bird (Figure 3).



(Figure 3) Some types of botanical element .[1]

2.2. Animals elements

Roman Artist used heads of animals, women and children, which their bodies take shape of Plants like acanthus plant, as also used in the three-dimensional form

in some places such as buildings elevations, palaces' fountains and palaces' garden as shown in figure No. 4 below .



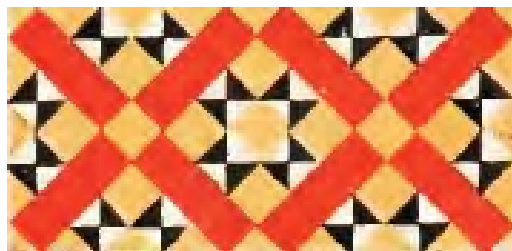
(Figure 4) Sample from using human figure and animal to create pattern.[2]



(Figure 5) Using human face and rhythm order.[5]

2.3. Geometrical elements

Roman used geometric shapes in their works and characterized by accuracy distribution, Consistency and perfect spatial relations. The organic and geometric patterns have a different shape, but it generated from same rules in partial case. The path and space used to fill the area in the regular shape with some rhythm and repetition . (Figure 6)



(Figure 6) The square shape and the processing of generating patterns .[1]

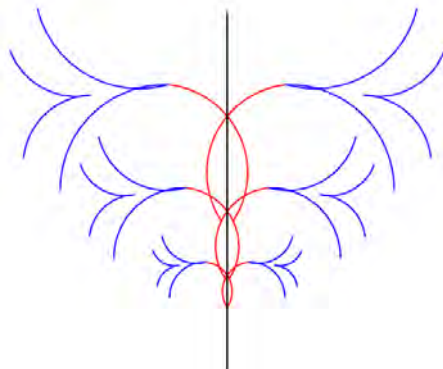
3. Roman Prototype Grammar

The basic reference for the Roman prototypes are the works of the Greek with some modifications in proportion. Where Roman distribution these prototypes in the column and to create the order and styles of each historical column. The most

important geometric relationships that exist in the Roman patterns are:

- Repetition.
- Rotation
- axial
- Scale
- Proportion

There are many relations among these rules, as example, the prototype can contains repetition with scaling in the same time (Figure 7). These rules can put in the AutoLisp Language easily and control of the design process with the other choice of this language as classify the one from these rules to two or three type as the next point in this study .



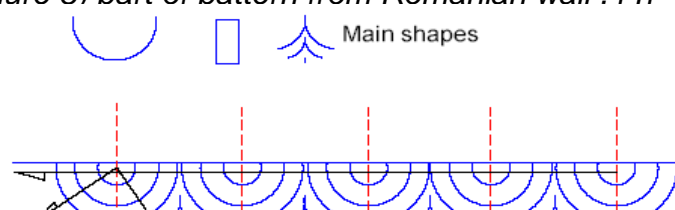
(Figure 7) Repetition with scaling to create prototype . [By researcher]

4- Deconstruction of the prototype shape :

In this stage of study, the Roman prototype will be analyzed by geometric method. The selected sample will be minimised to the linear Roman patterns that are reality present in the palaces and churches where will discover its elements, components and mechanism of installed and configured, as the following figures .(Figure 8)



(Figure 8) part of pattern from Romanian wall . [4]



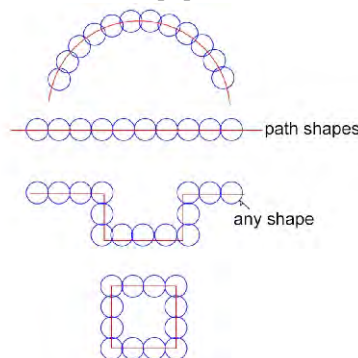
(Figure 9) Primary analysis for one of the Romanian prototype. [By researcher]

After reviewing the installation mechanism, deconstruction of the prototype and completion the geometric analytical study for prototypes elements, we can define prototypes installation variables, these variables discovered when some selected samples were analysis and deconstructed [9] , which are three causes:

4-1 Path

Roman buildings characterized by strict forms and stability Therefore, the patterns considered one of Architectural supplements which gave the Roman architecture simplicity and lightness where characterized by its horizontal and vertical direction besides curve direction like circular and arc windows frame. So we can say that these patterns have a specific path.

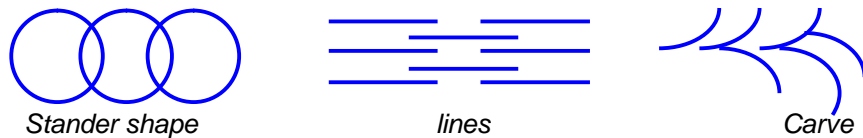
In this paper, the meaning of path is the whole form of prototypes where it may be linear or polygonal or closed. The path compatible with the form that intends to put the prototypes in or around. Through the program that will be design give the prototype paths directly to the Autolisp software to fill in or complete the prototype that has been destroyed or disappeared by drawing a prototype path. This element of creating prototypes used only to make linear prototype , so it is not for filling the large area like floor or ceiling decoration [1].



(Figure 10) Many types of path and direction . [By researcher]

4-2 Shape's type:

Identify the main shapes are very important, where the designer can generate prototypes through this process, and whenever the database of the main shapes large, the designer can obtained multiple forms of prototypes easier, while the type of shapes can be line or curved shape or basic form such as square and circle [8], The Roman prototypes used mixed of shape to create one pattern [1], so we can find large number of shape's type in the Roman prototypes .



(Figure 11) types of shape that can use to generate pattern.[By researcher]

From this shapes , The Roman prototype can be generated with the other type of shapes like part of planet as acanthus flower and the human picture as we see in the previous point.[1] (Figure 3-4-5).

4-3 Rules and Relations

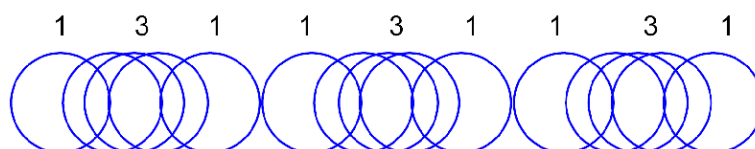
Many types of geometrical relations can be found in the Roman prototypes [4], that can be used to generate new models of patterns , the repetition ,rhythm ,rotate ,and size are the largest used in this prototype [10], so we can identify the rule and relation of prototype in three element [8] , as following (we used circle shape here to indicate any shape or element can using it in the future) :

4-3-1 Repetition

Three types of repetition can be discussed in this stage , some repetition have two or three transformation process as repetition with rhythm [10], besides the direction of repetition , can be found as columns , raws , radiant or linear path [8] , as following :

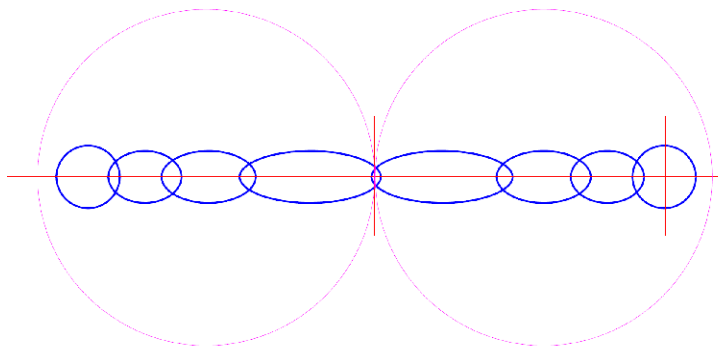
-Type of repetition : two type can be used to generate prototype .

1-Repetition with rhythm :



(Figure 12) The designer can select the rhythm and repetition shape and make a connection with the selective path .[By researcher]

- 2- Repetition with shape transformations : many type of transformation can be used to create prototype , but in our prototype we can use shape stretch and reflection or mirror as following :



(Figure 13) Repetition with shape's stretch & mirror reflection.[By researcher]

- **Repetition Direction : the are four type from this rule element :**

- 1- Vertical (columns): if the value of raw less than 2 unit, the column direction will be the active direction in the prototype .

If $x < 2$, $y > 2$ = y direction

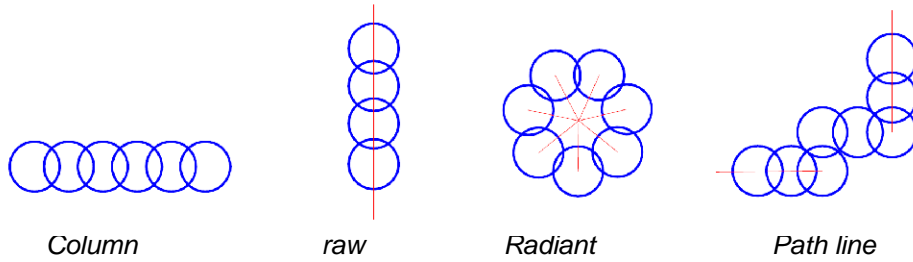
- 2- Horizontal (rows): the opposite processing of the previus point .

If $y < 2$, $x > 2$ = x direction

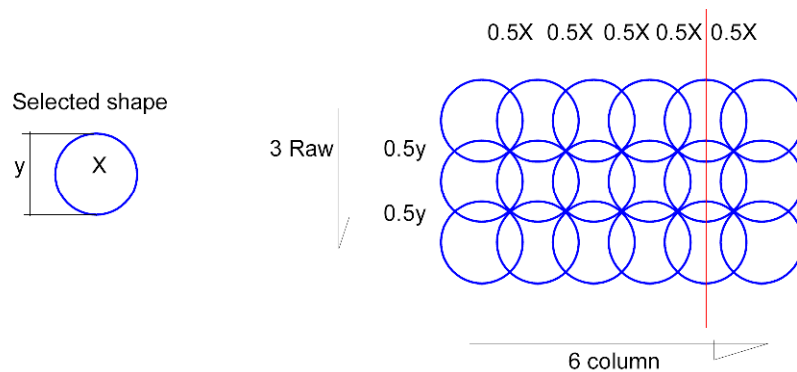
In most case the value of x and y direction more than two ,then the pattern shape contain columns and rows , as figure No.14 , The designer can select the value of x and y direction and distance between rows and columns .

- 3- Radiant : in this type the designer should specify the center point and the angle of repetition .

4- Continuous Path line : this rule link with one line that draw before selected the object .



(Figure 14) Four type of direction .[By researcher]

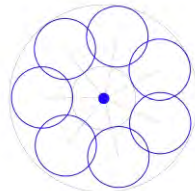


(Figure 15) The mixed type of Row and Column.[By researcher]

4-3-2 Rotate

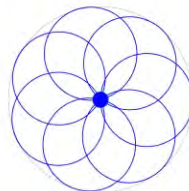
This element was using within repetition ,but in this section we show the type of rotation, that relate with the position of the start point of rotation as following :

- **Round start point** : (figure 16)



(Figure 16) Rotate the object round the center point .[By researcher]

- **From start point** : (Figure 17)

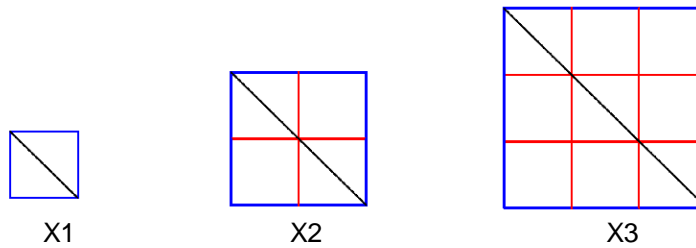


(Figure 17) Rotate the object from the center point .[By researcher]

4-3-3 Scale

There are three scales used to create Romanian prototype as Hamlin suggest, the three types are [1] [6] (figure 18):

- X * 1
- X * 2
- X * 3



(Figure 18) Three X scale .[By researcher]

5- How can use these rules to De and Re- construction of pattern ?

The designer can use these rules to generate a new models of prototype by using rules and applying it manually , but we make all this paper to make this processing Auto to generate this prototype by design sub software in AutoLisp language , and all above are as a database to apply the software , in other hand the designer can deconstructs the pattern manually by geometric analysis study as shown in figure No. 9. , this figure is sample from important ten samples were analysis to discover the rules of constructed the prototype and the ratio of using these rules and properties in these samples (table 1) :

(Table 1)The final ratio of using selective rule from selective sample.

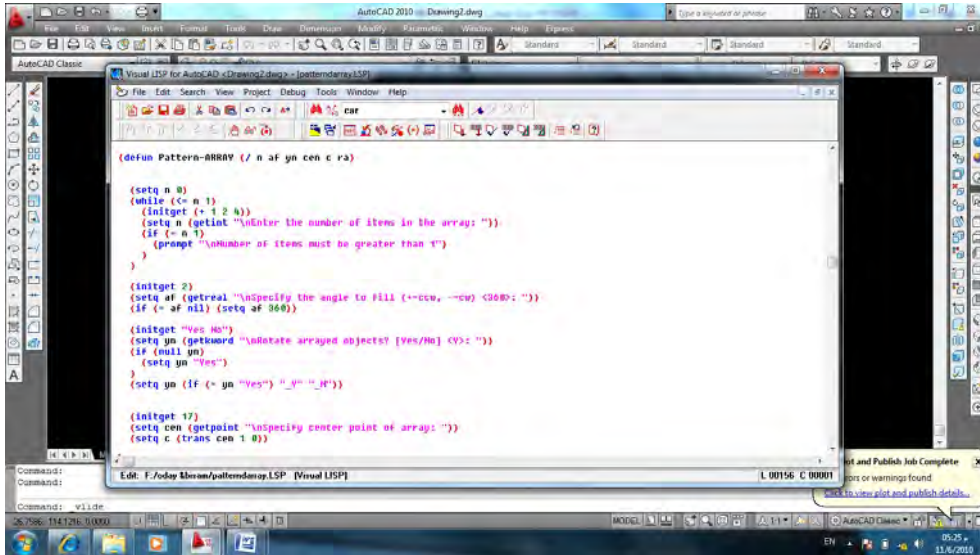
Rules and relations %										
Repetitions						Rotate		Scale		
Type		direction				Round	from	1X	2X	3X
With rhythm	transformation	Column	Raw	Radiant	path					
46	54	12	27	40	21	52	48	23	45	32

6-Re-construction for prototype by AutoLisp :

After the geometrical analysis completed for the Romanian prototype , and discovered the main processing to create pattern shape , The re-construction stage will be active by depending to the Autolisp language to generate new prototype with Auto generate method , so this program will need a correct data for getting a new patterns related with the Romanian style .

AutoLisp language taking the command manually form the user or designer (Figure 19), the main commands were programmed before running the software .

when program start [3] , The first selection shape will be active to began the processing or in the command bar the following question will appear (Select the shape for prototype ?) .



(Figure 19)The text box for Virtual Autolisp editor .[3]

After shape selected , The second question will appeared in the command bar (select path ?:(draw path/ select path /no path), this question for create path that the selective shape of prototype link with it, the designer can select or draw new path and in addition to design the prototype without path as following :

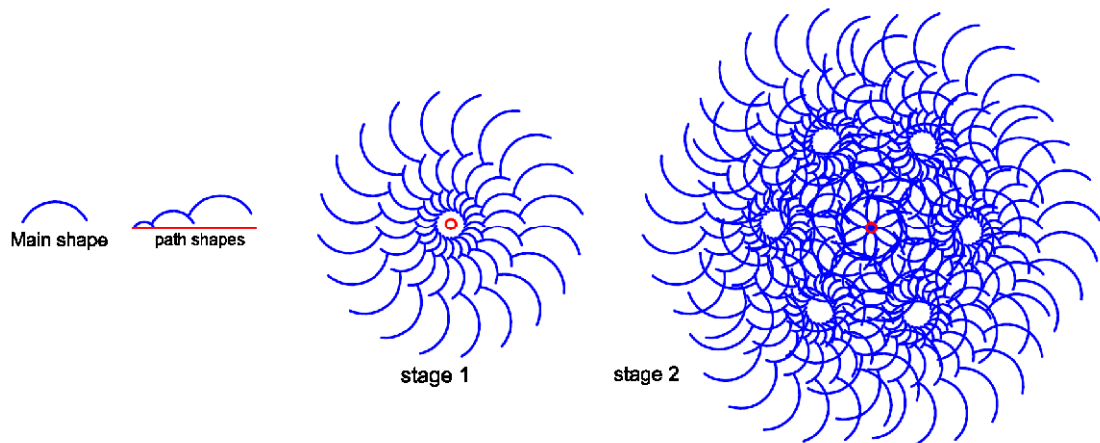
6-1 select path :

If the path is select as a choice, the next stage will be to select the rule of prototype that shown in the section five and table No.1 by giving the type of repetition , rotate and scale .

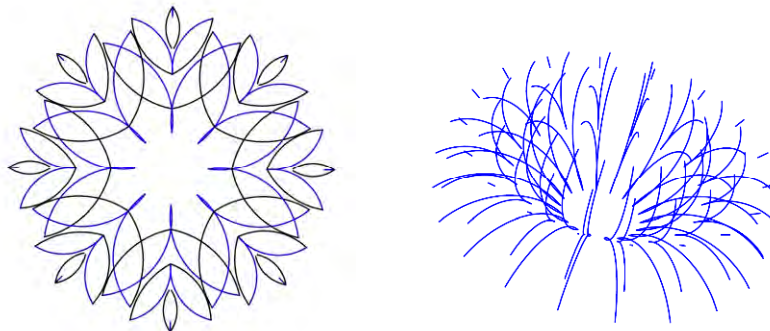
6-2 No path :

If no path is a choice , the next stage will be to select type of repetition only and the prototype will be as Raw and column .

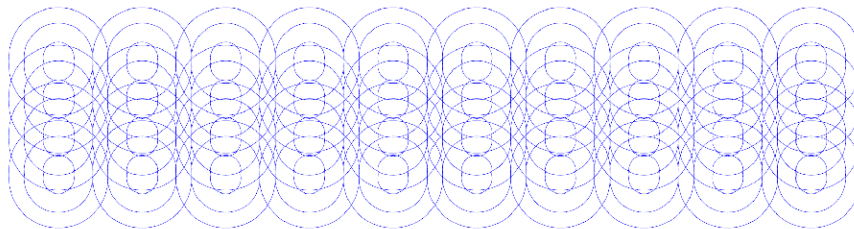
The next stage for auto generate for the prototypes are select start point (can use all input method , digital value , mouse , digital pen ..), then if the designer want to make his prototype as 3d pattern , he can select the z axes and run the design , below some sample of designed by auto generate method (Figure 20 -21-22).



(Figure 20) Curve shape and the model of prototype .



(Figure 21) 2D and 3D prototype from curve shape .



(Figure 22) Raws and colume may be create the path .

7- Conclusion

When the designer need to create any shape or prototype , this processing needs three sequent stages , the first one should need a trusty information from any architecture or art style or any information that related with region of work ,like

historical background ..etc, the second stage should be geometrical analysis and de-construction to its main shapes of selective prototype and discover the architecture rules that have been used to generate it, that used to re-construct the new models of prototypes by depend the Autolisp language in the last stage, this paper can be project to create a new software or sub-software with in Autodesk programs. In the other hand Roman's style contain three important grammars and elements to generate prototype like paths , shape's type and rules element that consists of three object , repetition with its three type , rotate within two type and scale and its three sizes, these grammars can change from style to style , so it is consider identity rules for any Architecture style .

8- References

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