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Redesigning Landscape Equipments with Parametric Design: The Case of Konyaaltı Expo 2016 Park[#]

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A R T I C L E I N F O	A B S T R A C T
	In this study, it is aimed to redesign some of the landscape equipment of Konyaaltı Expo 2016 Park with a parametric design approach and to compare the park with the existing ones. For this purpose, the landscape equipment's in Konyaaltı Expo 2016 Park, which was determined as the study material, were photographed, and analyzed. Using these data, opinions were taken from a group of ten experts, and it was determined which equipment should be redesigned. By targeting the redesigns to be made within the scope of the study, a literature search was made on the concept of Parametric Design and the examples made with parametric design were examined. Models of the new reinforcement elements proposed for Konyaaltı Expo 2016 Park were prepared with the Grasshopper tool and rendered images taken with the help of Lumion software. The evaluation of these designs in terms of aesthetics, economics and functionality, their suitability and how acceptable they are, was determined by asking the experts through a questionnaire. In line with the results of the survey, existing reinforcement elements and parametric design reinforcement elements were compared, and the possibilities and possible restrictions were examined.

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Introduction

During the 20th century, technology developed rapidly. The impact of technology has also manifested itself in the field of architecture, along with all disciplines. This development affected all the processes of architecture, and at the same time transformed these processes. Modernism, which is still effective even today, has changed architecture in every aspect, making it a phenomenon that interacts with every structure of society. It has become a metaphor that collects and reflects in detail the characteristics of modernism and the age of architecture. In post-modernism and its aftermath, the interaction between architecture and technology has increased radically and, in more detail, than in the past, but the most important interactions began to be experienced in the 1980s and after (Mendilcioğlu 2017).

In the Dictionary of the Turkish Language Association, a parameter is defined as a variable quantity that enters the coefficients of an equation in algebra (TDK 2022). In computer science, a parameter is a term related to the operation of a series of commands on various data entered into the system (Akipek and İnceoğlu 2007).

A parameter in design is defined as a factor that defines a system, determines or limits its performance (Baykara 2011). In parametric design, it is the design of the concept by determining the same parameter within the framework of certain parameters (climate, sun, wind, etc.). The change that occurs as a result of different values entered in the parameters in the system designed in the computer environment is used for form production at the design stage or for light-sound-form changes in the physical space. The advantage of controlling the parametric design with parameters is that it provides the opportunity to intervene in the product at every stage of the design, from the sketch stage to the final product stage. Contrary to traditional architectural principles, a digital environment has been provided where amorphous forms can be designed much more easily.

Branko Kolarevic defines parametric design as follows: Parametric design is defined as the parameters of a particular design, not its shapes. By assigning different values to the parameters, different objects or configurations can be created. Using equations, the relationships between objects are defined and more multiple (complex) geometries are obtained that are interconnected. In this way, it is possible to connect objects and transform the behavior of objects (Kolarevic 2003). Although the term "parametric design" first appeared in Maurice Ruiter's thesis written in 1988, it is known that Luigi Moretti tried to relate the concept to design and architecture in the 1940s. Moretti talked about parametric design in detail in his plan notes for his stadium, which he designed using parametric algorithms. In 1960, he described in his plan notes how and in what ways he used the stadium he designed for the "Twelform Milan Triennial" about things like the economic cost of concrete, from acoustics to natural lighting, from the stadium's geometry to the viewing angles, and the relationships between the dimensions connected to these parameters (Davis 2022). Today, parametric design methods and software have become widespread, especially façade system solutions, form-geometry searches, the relationship between land and design, different geometry building productions and conceptual relationships related to parametric design method are widely carried out. It is thought that landscape reinforcement elements designed with parametric design understanding are one of the most up-to-date methods that can be used in design and are more aesthetic, functional, appropriate, and acceptable than traditional reinforcement elements. Within the scope of this study, Konyaaltı Expo 2016 Park reinforcement elements that need to be redesigned with a parametric design approach were determined by expert interviews and new designs were realized instead of some existing reinforcement elements of the park. After the evaluation of these new designs with expert interviews, the possibilities and possible limitations of parametric design tools were examined.

Materials and Methods

The main material of the study is Antalya Konyaaltı Expo 2016 Park, which has the central campus of Akdeniz University in the north (Figure 1). As a result of the studies to be carried out within the scope of the research, first, literature research was conducted on the concept of Parametric Design, samples made with parametric design were examined and information about the designs was included.

Konyaaltı Expo 2016 Park, which was determined as a working area, was visited in January 2022, the reinforcement elements were analyzed, and photographs were taken. Ten expert opinions were obtained with the photographs of the reinforcement elements and the 3 reinforcement elements with the most votes were selected among them. According to the results of the survey, the reinforcement elements that received the most votes; bench, pergola and long bridge (Figure 2). In this context, models were created with the help of the 'Grasshopper' tool of Rhino software, which is one of the parametric design tools, which works as a plug-in.
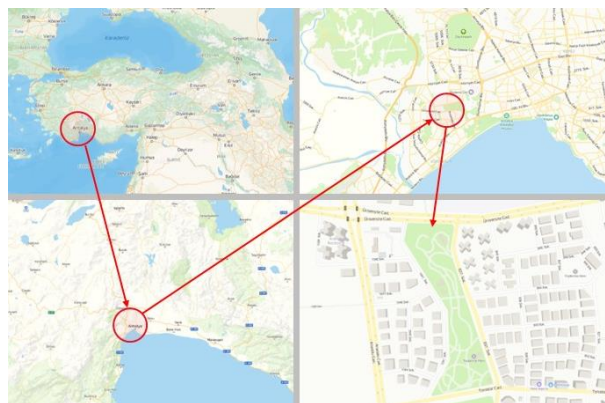

Figure 1. Study Area: Expo Park

Figure 2. Reinforcement elements that were decided to be redesigned

Grasshopper works as a plug-in of the Rhinoceros software. Launched by David Rutten in 2007, the plug-in is a plug-in that allows parametric design, as well as a program that allows various algorithmic data to be entered and transformed into complex design patterns at Rhinoceros. When it was first released, the program announced its existence under the name Explicit History under the Rhinoceros program and received its official name in 2007. With the Grasshopper plug-in, the reinforcement elements have been parametrically redesigned. In the last part of the research, the evaluation of the modeling made with parametric design in terms of aesthetic, economic, functional aspects, their suitability and how acceptable they are evaluated by asking the experts through a questionnaire and their opinions were included. In line with the results of the survey, the existing reinforcement elements and parametric design reinforcement elements were compared and the possibilities and possible limitations were examined.

Results

The study area is located between latitudes and longitudes 36°53'07.2" North 30°38'27.9" East. To the north is the main campus of Akdeniz University. In the park area, there are 3 pools with a total of 2 420 m² water and light shows, an amphitheater for 500 people and 2 cafeterias and art centers with indoor and outdoor areas with a capacity of 150 guests each. It was chosen because it is a park with a lot of functionality and a lot of visitors because there is a 780 m long running track surrounding the park. The size of the selected area is 30,000 m².
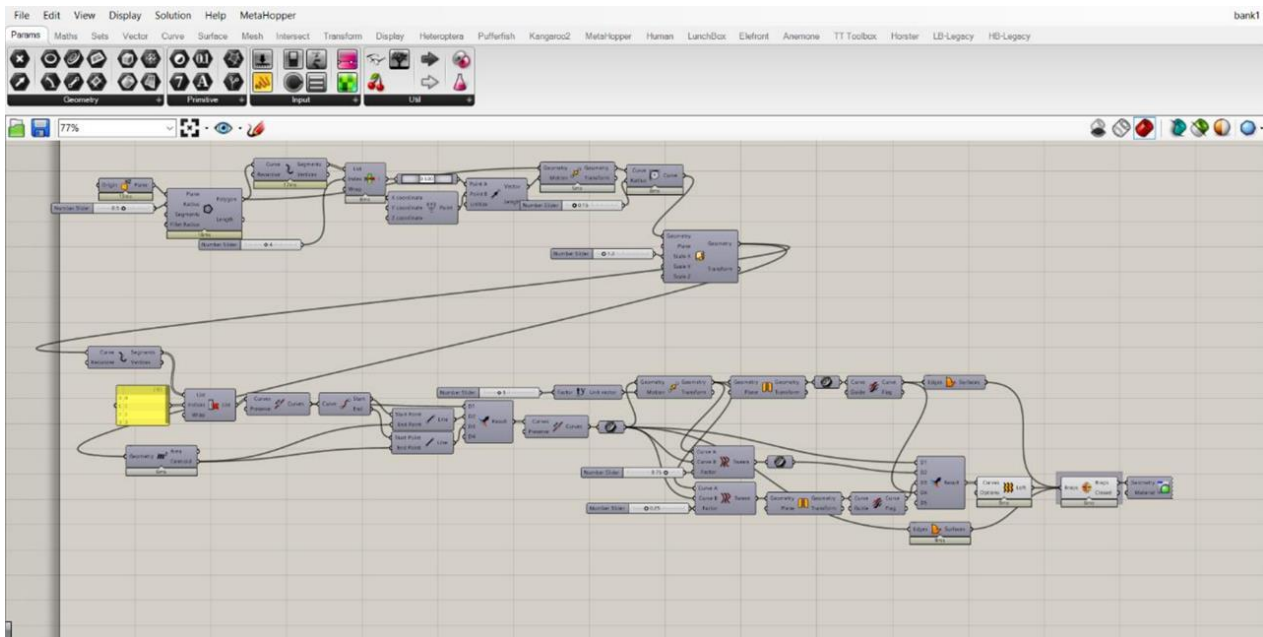
Figure 3. Parameters of the designed bank with the Grasshopper plug-in (Original 2022)

In the study area, there are a total of 8 kinds of reinforcement elements other than flooring elements and walls. These are: bench, seating wall, pergola, bridge (big bridge, small bridge), lighting (tall lighting, bollard type lighting), trash can. The visuals of the found reinforcement elements were presented to the experts and the 3 reinforcement elements that received the most votes among them were redesigned. Reinforcement elements selected by experts for redesign, bench, pergola, long bridge.

There are 35 benches scattered in various regions within the park. The width of these benches is 160 cm, the height from the ground is 50 cm. There are 3 different colors of the uniform bench in the area. There are 23 seating walls scattered in various areas within the park. The width of these seating walls varies between 75-120 cm; The height from the ground varies according to the area where it is located. There is a uniform and single-color seating wall in the area. There are 46 pergolas scattered in various regions within the park. There is a picnic table under each pergola. There is a uniform and single-color pergola in the area. There are 3 large bridges in the area. The length of the bridge varies between 30-40 meters, one of which connects two different entrances of the park. The materials of the bridge are steel, wood and glass. There are 7 small bridges in the area. Bridge lengths vary between 3-10 meters. It provides passage over the water element in the park. Bridges are uniform and the material used is wood.

For the Parametric Modeling of the Bank as a Seating Element, a hexagonal polygon was created with the polygon parameter connected to the AI origin parameter, fragmented by polygon explode and cull index parameters, the shredded curves were recombined with the merge command and the form of the bench was formed; this form was moved by move parametry on the y-axis, mirror image was taken with the mirror parameter, and the same curve was moved to two more places at the midpoint with tween curve, and these curves were combined again with the merge command and connected to the loft command to obtain a bank. Values such as the radius value of the polygon used in the creation of the bank, the fillet value, how much to move on the y axis can all be changed with the number slider parameter, and different results can be obtained (Figure 3).

For Parametric Modelling of the Pergola, the length of the pergola on the y axis was determined with the Line SDL parameter. With the divide curve parameter connected to the Line SDL parameter, the length is divided into 4 parts, and the Arc parameter creates arcs on these points in the AI plane. The created arc was fragmented with the divide curve parameter and 3 different points were determined on the curves with the list item parameter, and these points were connected to the arc parameter again to form a new arc, and the surface of the pergola was obtained by connecting the loft parameter. The created surface was divided into pieces with the random reduca parameter, 2 different geometry parameters were defined to the separated parts and two different color parameters were connected and different materials were assigned to these colors in the rendering program. In the formed pergola, the length of the pergola; angle, radius values of arcs, point values determined on arcs; the number of separated parts of the surface on it can be changed via the number slider parameters; The location of the curved structure created in the upper cover of the pergola was changed via the point on curve parameter and different results were prepared on the model (Figure 4).

Parametric Modeling of the Bridge First, the curve was drawn in the Rhino program and the form that would form the ground of the bridge was determined. The curves drawn in Rhino with the curve parameter in Grasshopper are defined on Grasshopper. The curves are divided into 60 parts by connecting to the divide curve parameter. The points divided into 60 parts were connected to each other with the line parameter, and the ground surface was obtained by connecting the loft parameter to this parameter.
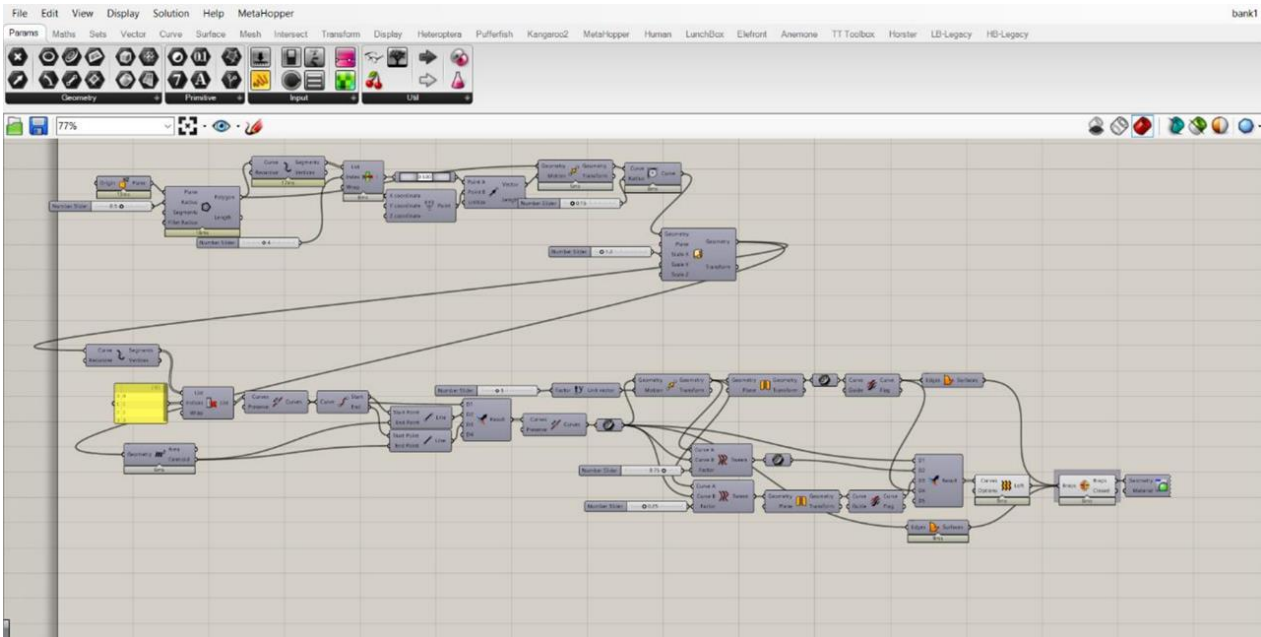
Figure 4. Parameters of the designed pergola with the Grasshopper plug-in (Original 2022)
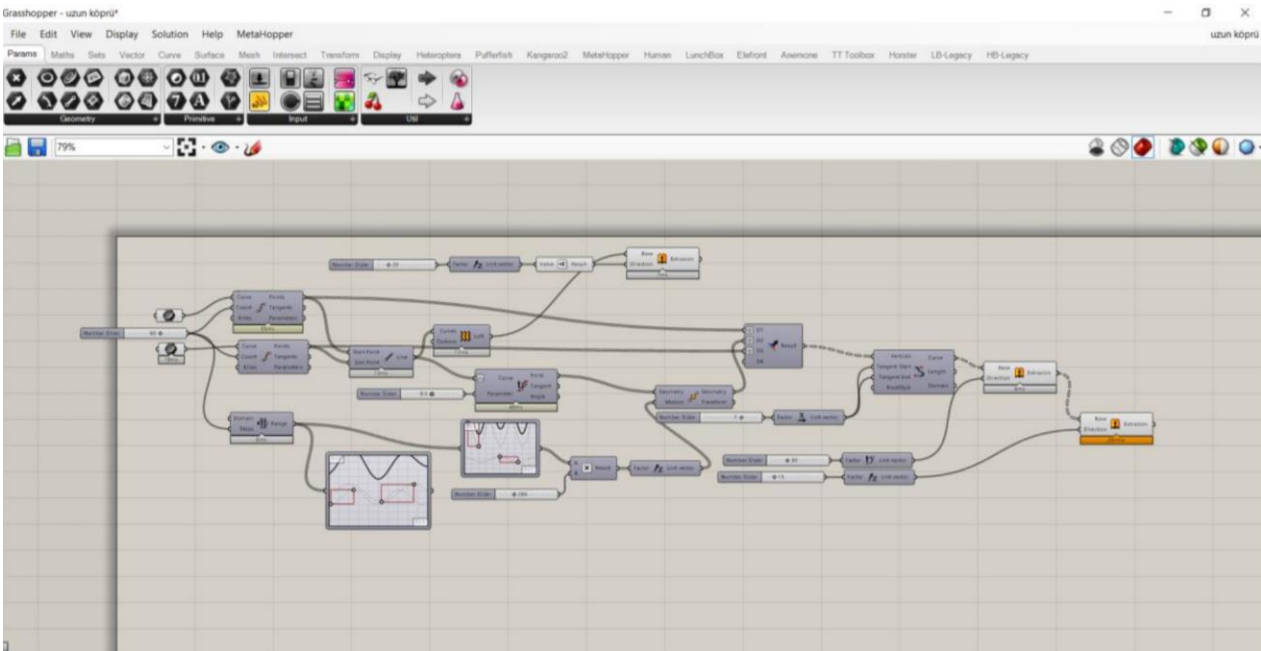

Figure 5. Parameters of the designed bridge with the Grasshopper plug-in (Original 2022)

With the evaluation curve parameter connected to the line parameter, the points on the ground were brought to a place in the middle part and these points were moved on the Z axis, and the top cover form of the bridge was determined by connecting the graph mapper parameter to the moved points. The curve points forming the bridge floor are combined with the merge and interpolate parameter and the points moved to the Z axis are combined with the extrude parameter. In the created hyperlink; the general form of the bridge can be changed by changing the type of graph mapher parameter, manipulating the lines on the parameter, the height of the points moved to the Z axis; the upper cover intervals, the thickness values of the top cover can be changed with the number slider parameters, different results can be obtained (Figure 5).

For the models created at this stage of the study, 3D perspective images were prepared in Lumion software. The image prepared for the bank is given in Figure 6.

The perspective image prepared for the pergola is given in Figure 7. In order to question whether they are compatible with the prepared bench design, two reinforcements are included in the perspective together.

The perspective image prepared for the bridge is given in Figure 8.

The rendering images of the new reinforcement elements made with the parametric design were presented to the experts and evaluated in terms of aesthetic, economic, functional, suitability and acceptability with the existing reinforcement elements.
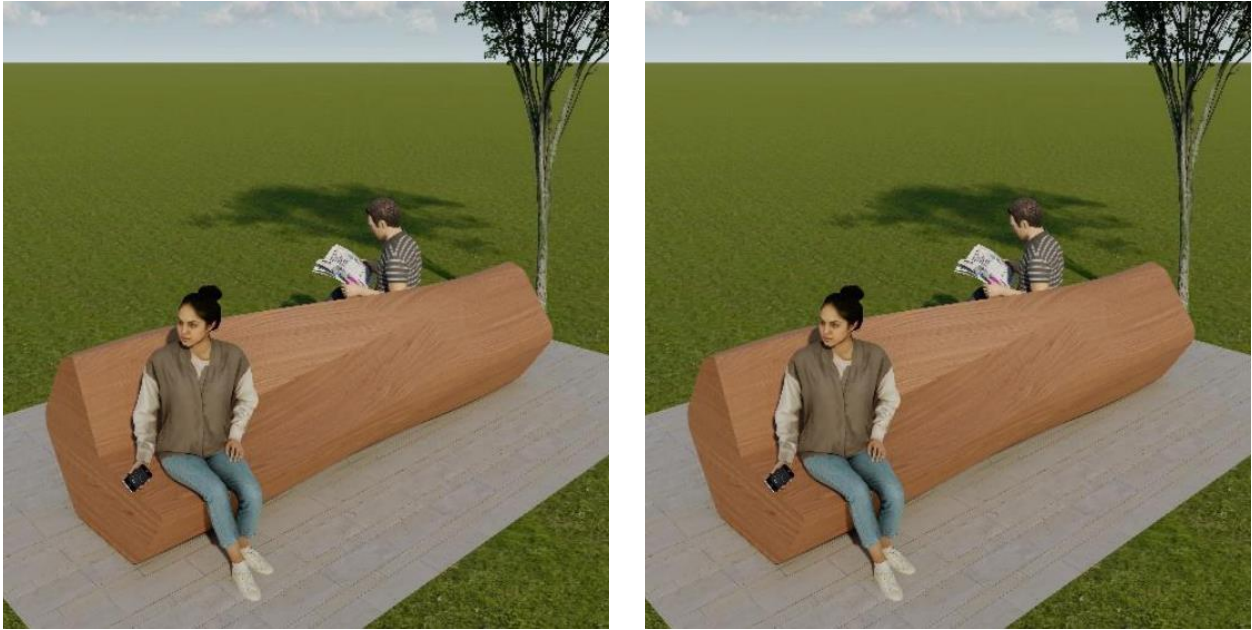
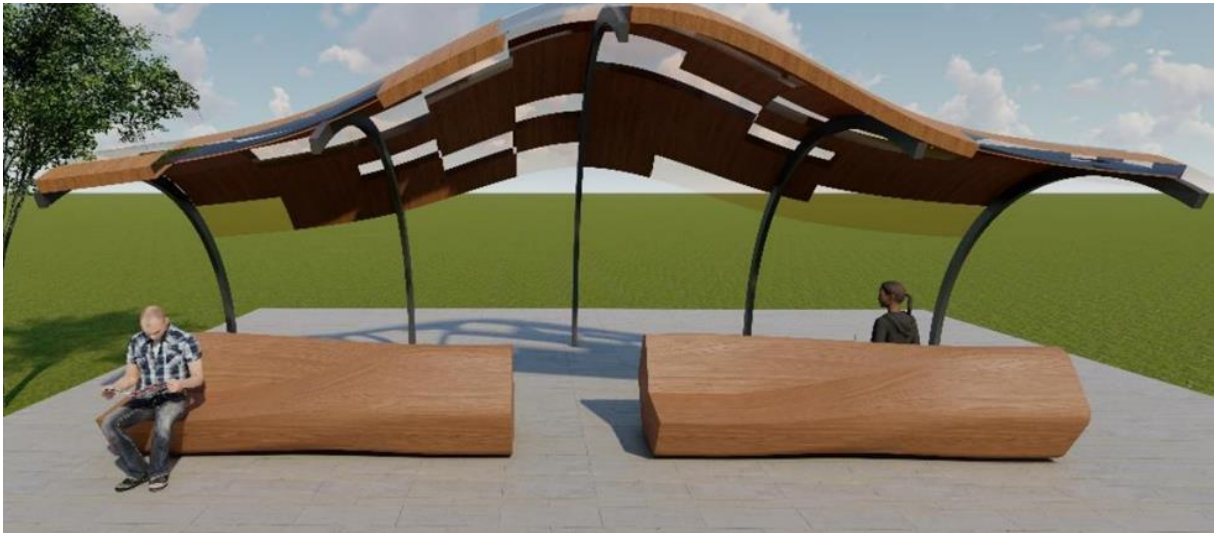Figure 6. Perspectives of the designed bench design (Original 2022)

Figure 7. Perspectives of the designed pergola design (Original 2022)

Figure 8. Perspectives of the designed bridge design (Original 2022)

As a result of the evaluations, it was found that the new reinforcement elements made with parametric design were found to be more aesthetic than the existing traditional reinforcement elements and when evaluated in terms of suitability and acceptability, it was concluded that an unusual design would attract the attention of the users in the park and thus be accepted by the public.

From a functional point of view, the upper cover of the new bridge, which is designed parametrically, has been found to be more functional than the existing traditional reinforcement elements due to the fact that it provides shading and the benches provide seating on both sides, and in addition to this, an expert opinion has stated that the existing traditional reinforcement elements and the parametric designed reinforcement elements undertake the same function from a functional point of view.

When the designs are evaluated from an economic point of view, it is stated by the experts that it cannot be economical because it uses more materials than the existing reinforcement elements and requires more workmanship.

An expert opinion indicates that the materials used in the designed bridge; that using the same or similar material to the designed pergola and bench would provide more harmony in the park; another expert completely disagreed with this view and stated that it would be better to use different materials in the top cover as the bridge is larger than the other reinforcement elements and it is likely to attract more users to the park because it can create a focus in the park from the outside.

An expert opinion stated that it would be appropriate not to use any materials instead of the translucent glasses used in the upper cover of the designed pergola, or that it would be appropriate to use wooden slats instead.

Conclusion and Discussion

Parametric design is the process by which a complex design can be transformed into a simple composition and its alternatives can be derived. By combining these alternatives with the virtual environment, it becomes a defined process from the creation of the geometric form to the analysis and project management that will enable the structural form to be reconsidered.

It is seen that parametric design provides new directions according to new forms or environment by making the necessary analyzes (structure, environmental analysis, etc.) not only to produce form and space, but also through the produced model.

Parametric modeling is mostly used to create geometric forms, but in order for the designed forms to pass to the application stage, the details of the building units (material, cost, etc.) used in the design must be given. This information facilitates interdisciplinary work and reveals very important details in the construction process.

For the study, a lot of experimentation was performed with the Rhino Grasshopper interface in order to learn how the program works and the logic of its operation as part of the research process. In this process, problems such as deletion of some files, loss, not reopening them, and spontaneous closing of the program during work were encountered.

As a result of the study, it can be accepted as verified that parametric design is one of the most up-to-date methods that can be used in the design of landscape reinforcement elements and that it can help to design more aesthetic, functional, appropriate and acceptable reinforcements than traditional reinforcement elements. The impact of the virtual world and the development of digital technologies on the form language of the 21st century, the fact that topological geometry, also called 'fluid form' in design, stands out as one of the main characters of today's form language, and the ability of today's technologies to represent these forms in a more realistic and informative way cannot be ignored. However, especially in recent years, developments in design technology and new software will enable parametric design to be used by more designers.

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