




Computer-Aided Design Method of Parametric Model for Landscape Planning

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Abstract. Urban planning and design, landscape planning and graph and architectural layout have gone through progressive adjustments with the creation of the digital era, mainly in the landscape planning and graph process, the emergence of computer-aided plan technological know-how, parameter control and optimization behavior has brought new efficiency, new methods and new thinking mode to the design. This paper studies the multi-objective optimization through the parametric design of design practice, in order to learn about the operational technique of parametric plan in panorama structure layout practice. In the manner of plan exercise, taking the design practice as the object, setting the main goal, through a lot of simulation calculation and data evaluation work, from the perspective of the design mode of the specific practice stage, the parametric landscape architecture design is discussed in detail, and its characteristics of high efficiency, universal, multi-objective, sustainable and optimization are explained. It is proved that parametric design can greatly improve the efficiency, shorten the design cycle, quantify the reasonable design and other aspects of the related content. It has a strict logic algorithm process, which brings new development to the design and has a strong driving force in this field.

Keywords: Computer aided design; Landscape architecture planning; Parametric design; Landscape design logic, Nonlinear design

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1 INTRODUCTION

Traditional urban, architectural and landscape planning are basically based on pen and paper to achieve the production of design scheme, especially before the popularity of computers, designers in these industries need to have solid professional design and painting ability at the same time, and bear more responsibilities. With the rapid development of science and computer technology, the city, architecture and landscape planning introduce computer technology for aided design, which not only enriches the traditional design methods, but also greatly reduces the labor of

designers, thus effectively shortening the design cycle. With the speedy improvement of financial system and the increasingly more distinguished environmental problems, human beings pay extra and greater interest to the development of panorama structure [1]. China has gradually increased the attention and investment in landscape architecture construction, which notably promotes the improvement of panorama planning and design. In particular, the introduction of pc utility technological know-how makes the panorama planning and format from the topographic survey to the manufacturing of graph scheme, and then to the manufacturing of drawings and even the simulation of house environment. This series of programs have tended to be patterned. Whether it is Auto CAD technology, Arc GIS technology or VR technology, it has progressively penetrated into the complete manner of panorama planning and graph [2]. With the assist of these applied sciences and software, designers can create their own works more quickly and conveniently, and help designers design more perfect works through the creation of three-dimensional space environment.

With the development of society, the era of digitization and informatization has already come, and parametric design, as an important aspect, has gradually emerged in some design fields, and landscape design is still in the initial stage, but it is not willing to fall behind the rapid development. At present, when the pursuit of diversification of forms reaches a certain degree, the focus of design has gradually returned to its scientific, logical and functional aspects. Here, with its unique way of thinking and design methods, parameterization has entered the field of landscape design, and has a profound impact on the thinking logic and design philosophy of landscape designers. Parametric design, as a kind of design method, brings new working method and design pattern to designers. Parametric design emphasizes logic, order and functionality. It is a bottom-up design with complex relations between various parts of the whole. At the same time, it is also a design pattern that emphasizes the collaborative work of multiple disciplines and specialties. Its design system is pluralistic, dynamic and multi-dimensional, with strong inclusiveness and complexity, which is very consistent with today's world [3]. In addition, it is also one of the aspects of digital technology, which has an innovative influence and guidance on the traditional design process and design methods. Through the computer technology platform, various disciplines will be aggregated into an information platform, multi-dimensional, multi-faceted analysis, making the design more three-dimensional, more convincing, and making the presentation of design more direct and more efficient. Through the collaborative work of various disciplines, each profession has made great progress. Its impact on landscape design is not only the change of form, but also the fundamental innovation from the aspects of design theory, design mode, design process and construction method [4].

The main contents of this paper are as follows: the first chapter introduces the research background and significance of this paper, and puts forward the research methods and contents of this paper; The second chapter discusses the related work. The third chapter analyzes and studies the parametric design of landscape planning. In the fourth chapter, the design and application of parametric model of computer-aided landscape planning are analyzed. The fifth chapter summarizes the whole paper and makes a prospect.

2 RELATED STUDIES

In the field of architecture, parametric research focuses on the generation of form, or the research of formal logic, which mainly uses algorithms to express the logical relationship between parameters. The purpose is to simulate and describe the generation process of architecture and artificial environment including villages and cities through artificial intelligence. The parameterization strategy of landscape architecture combined with the self-discipline of landscape architecture discipline, combined with the research results of related disciplines, can be used for reference selectively. With the improvement of digital strategies and technological know-how represented through parametric design, panorama planning and format can go past the normal layout process, and obtain the ability of scientific, objective and rational cognition and analysis of landscape environment operation and development law. As a new sketch method, panorama

planning parameterization has been extensively involved and developed in current years. In current years, there are many progresses in the parametric layout and application of landscape architecture planning, some of them are as follows:

From the birth of parametric non-linear architectural design to the discussion of parametric landscape planning and design methods, French postmodern philosopher gill Deleuze has published relevant philosophical thoughts and theories. The philosophical viewpoint of advocating immediacy and contingency has become the reflection of nonlinear complex scientific theory in architecture, especially his interpretation of pleat, smoothness, diagram, generation and other concepts, which has a direct impact on the way the world's avant-garde architects look at and solve problems. The research on parametric design method has been carried out by foreign new designers more than in China. With its unique and mature views on parametric ideas and design techniques, London architectural alliance college, UK, believes that landscape is an open and unpredictable complex adaptive system under the research of nonlinear system. A tropical forest model was established by using parametric software to study the influence of natural disasters on plants in natural system. The application of parametric design technology and technique is elaborated in detail in Gaytan. Beno T R et al. mentioned the definition of parametric format and parametric design, from the simple good judgment of parametric format to the technical platform and the normal relationship, to supplement and update the domestic parametric theory from a more in-depth perspective [5]. These studies constantly update the theory of parametric design, and lay the foundation for the application of parametric design theory in landscape architecture.

Variation teaching is a way for teachers to transform the form of problem representation, change the extension of concepts, change conditions or conclusions in the actual classroom so that students can see the essence of the problem and explore the laws of mathematical objects in constant variations. Variation teaching about mathematical concepts is to change the irrelevant non-essential characteristics of mathematical concepts in mathematics class, to seek the same in the change so that they can gain the knowledge of abstraction in the change and improve the abstraction ability of students. Mathematical concepts are inherently abstract and not easily understood. Students cannot directly accept many mathematical concepts, and for such abstract concepts, students can draw on their perceptual experience. For example, the concept of a heterogeneous straight line for the second-year students is relatively abstract, especially the poor sense of three-dimensional is not easy to understand. The concept of a heterogeneous straight line in three-dimensional space is difficult to feel intuitively with two-dimensional plane graphics, so teachers can use a variety of teaching. Mathematical concepts have boundaries, and the properties outside the boundaries are called the extents of the concept. According to the essential connotation of the concept and the nature of a specific thing to determine whether it belongs to the concept extents or extents. Variation in the space of extensions is an effective way to optimize the mathematics variation classroom.

Under the trend of the continuous emergence of foreign and domestic parametric design theory, landscape architecture circles also began to study parametric design, led by scholars from Tsinghua University, Beijing Forestry University, Tongji University and other universities, carried out relevant research and Practice on parametric design method. Pena S B et al. discussed the construction of non-linear landscape design thinking concept in the paper [6], combined with the composition of information technology, with non-linear thinking concept to supplement and update the theoretical development of landscape architecture discipline, and additionally laid a theoretical basis for the utility of parametric graph in panorama architecture. In his paper, he analyzed the research, schooling and exercise of parametric layout abroad, summarized the blessings and issues of parametric plan in the discipline of panorama architecture, and concept about the improvement route and method of parametric diagram in Chinese panorama structure planning and design. Balbi M et al. discussed the basic concepts of landscape parametric design, summarized the problems faced by the current landscape parametric design [7], and put forward the parametric design system; Liu H mentioned the importance and connotation of digital method in panorama structure planning and plan [8], made a schematic sketch of digital strategy, and analyzed the primary digital techniques and technologies, their software scale and improvement

direction; Lke V et al. put ahead the definition, traits and thinking pedigree of panorama structure digital planning and sketch [9], Duflot R et al. analyzed the digital plan technique and utility software program platform in the thought pedigree in detail, and summarized the drift chart of panorama structure digital planning and graph [10]. The research results of parametric design and its technology platform construction model method theory have been gradually rich, and the theory is also gradually rich. It has important innovation value to construct terrain analysis with its idea and logical construction method.

3 PARAMETRIC DESIGN OF LANDSCAPE ARCHITECTURE PLANNING

3.1 The Concept of Parametric Design

Parameter and parametric are closely related. A parameter is an application to a given parameter. It can be assigned a constant value. In general, it refers to a variable, which is used to control other variables that change with it. Parameterization refers to the institution of a precise relationship, when a simple aspect of the relationship changes, different factors will additionally exchange, so as to ensure that the defined relationship is unchanged. Parametric design has appeared in the field of industrial design many years ago, but it only appeared in other fields after the 2000s. In the calculation program of architectural design, the use of parametric technology and pure product design should be different [11]. It needs to coordinate with many social factors and integrate various relevant influencing elements, such as the development level of technical ability and various social ideologies; The rapid development of the changing society requires the development of functions to be predictive of the future; The development of theory is influenced by more and more things, such as the new theory of everything, emergence theory and so on. Parametric design will appear in the field of architectural design under the comprehensive influence of many aspects.

3.2 Parametric Landscape Architecture Planning and Design Mechanism

Paradigms and fashions represent the groundwork of deciphering the mechanism of parametric panorama structure planning and design, and give an explanation for the parametric panorama structure planning and layout from the theoretical and technical levels. From paradigm to model, it reveals the process from law interpretation to form generation [12]. From the metaphysical point of view, paradigm and model are both a presentation of methodology, neither a typical and ingenious method, nor a specific path and Strategy: from the metaphysical point of view, paradigm and model can guide the way and method of generative design. It can be seen that the research of parametric landscape architecture planning and design mechanism not only has a high degree of methodology, but also comes from design practice, and will ultimately guide design practice. Parametric landscape architecture planning and design mechanism is shown in Figure 1.

The construction and application of parametric model optimizes the traditional design process and presents the characteristics of systematic design thinking and dynamic. The traditional design process relies more on the designer's experience and feeling: first, the general idea and design strategy of the scheme are carried out in the mind, then the manual sketch is drawn, and then the preliminary scheme is modeled by using h-dimensional design software, and the scheme is repeatedly deliberated, adjusted and modified in the process of sending, and the drawings are drawn after the scheme is finally determined. The application of parametric model has changed this situation. Relying on the parametric model, the designer determines the factors that affect the design as parameters. Through the construction of the model, the elements of the design system are associated, and the design process is described. Finally, the computer platform is used to control the generation of the final design results by adjusting the parameters. This kind of design method is bottom-up, based on process logic thinking, considering the reality of the place and the role of various elements of the system in the design, which is more rational and accurate. The design cannot be obtained by strict calculation. The parameterized landscape planning and design model is based on logical reasoning and describes the design process, not the calculation formula.

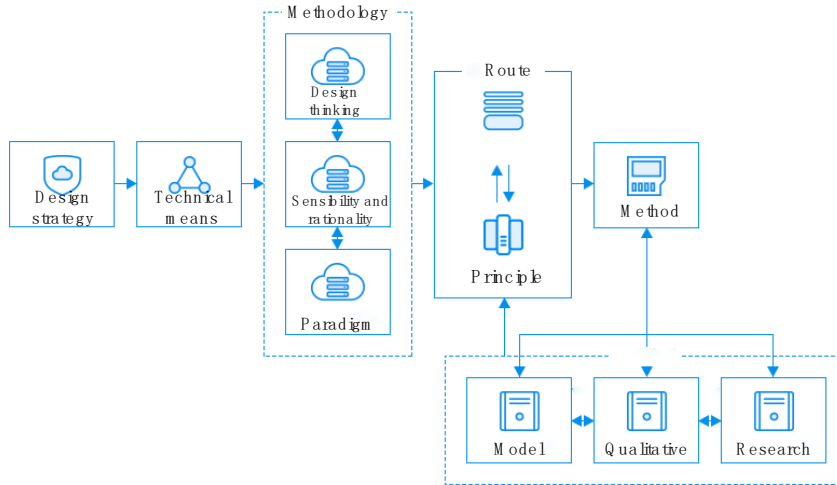


Figure 1: Parametric landscape architecture planning and design mechanism.

3.3 The Process and Operation of Parametric Design

The parametric design method based on "generative modeling" is close to the way of thinking of the design itself. It can assist the design field in a larger scope and improve the design efficiency. The operation of its operation platform is compatible with the drawing software, and can be realized through visual operation. It is easier to use than script and other computer language platforms, and improves the convenience of use, it allows us to use variables to control the generated shape, so that the design has greater flexibility, and greatly improves the workflow. It is the mainstream design method in use. Figure 2 shows the parametric landscape planning and design process.

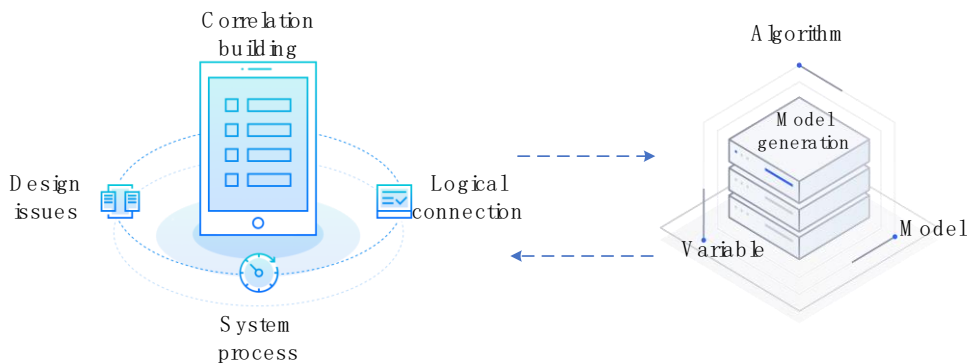


Figure 2: Parametric landscape planning and design process.

The first step in the process of parametric landscape planning and design is to select parameters and variables. The factors influencing the design are variables, and the design factors selected according to the design purpose are parameters; The second step is to find some or several suitable algorithms as calculation rules; In step h, the parameter relationship is constructed through the combination of algorithms to describe the design system and generate the parameter model; Finally, input parameter information in the computer language environment, take the algorithm model as the calculation rule, and get the final result, that is, the design scheme dimension corresponding to the design purpose. The construction of parametric model makes the design more flexible and can meet the requirements of multi elements and system complexity of

landscape planning and design. Through the change of parameters and variables, based on the algorithm model, we can use the powerful computing power of computer to get different results quickly, which is convenient for the control and comparison of design. At the same time, the modification and adjustment of the algorithm model can optimize the design process and produce the design results that meet the design requirements to a higher degree. The parameterized algorithm model provides an abstract and logical process model for landscape architecture planning and design, which can feedback quickly, which is difficult to achieve by traditional planning and design methods. Operation process of parametric model for landscape architecture planning is shown in Figure 3.

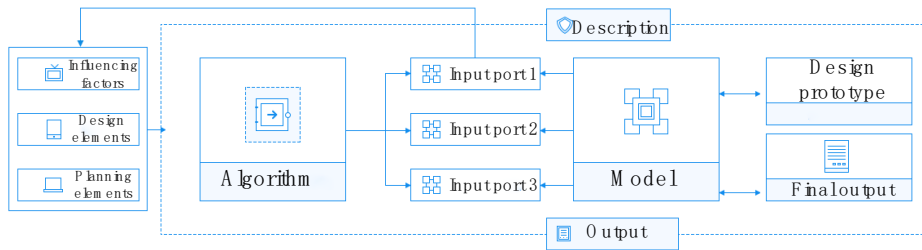


Figure 3: Operation process of parametric model for landscape architecture planning.

4 APPLICATION OF PARAMETRIC TECHNOLOGY AS DESIGN METHOD

Landscape terrain is one of the elements of landscape architecture design, and it is the objective existence condition of creating landscape atmosphere. Based on the elevation analysis, contour analysis and surface runoff analysis of landscape topography, this paper selects the terrain and mountain range of the scenic spot for experimental research. The landform has certain complexity and regional representation, rich vegetation types and strong historical legend site memory, which can provide effective site analysis data for the future development of the scenic spot.

4.1 Terrain Elevation Analysis

Terrain elevation evaluation is based totally on DEM facts to set up the ordinary terrain model, in accordance to the vicinity and top of terrain elevation factors to decide the terrain elevation of the average terrain, and show the relationship of terrain elevation with the aid of color. Terrain elevation evaluation can assist designers apprehend the landform and the common elevation of the site, intuitively apprehend the elevation distinction between the best possible factor and the lowest factor of the site, make designers suppose about the peak distinction cure of the site, enlarge the rationality of the layout scheme, and beautify the feasibility of the scheme construction, it presents a handy way for large-scale planning and layout tasks to interpret the site. The evaluation precept of grasshopper good judgment building is to pick out up the grid floor of terrain model, decompose the elevation factors on the grid surface, gain the coordinates of all elevation points, organize the facts on the Z axis from small to large, and symbolize exclusive elevation values via unique colors, The terrain elevation evaluation floor is shaped in accordance to the corresponding show shade of the terrain elevation value, and the legend is made in accordance to the corresponding price and color. Figure 4 shows the construction of the logic of terrain elevation analysis.

Based on the logic construction analysis principle of grasshopper, the terrain model of the scenic spot is imported into the logic system, and finally the color plane analysis map of Figure 5 is generated. It can be seen from the map that the highest elevation of Zhongshan scenic spot is 660 meters, and the lowest elevation is 58 meters. The range of elevation is shown by the transition of color. The whole site is high in the South and low in the north. The terrain gradually decreases from the high scale of the center to the surrounding area, showing the geomorphic characteristics of convex terrain.

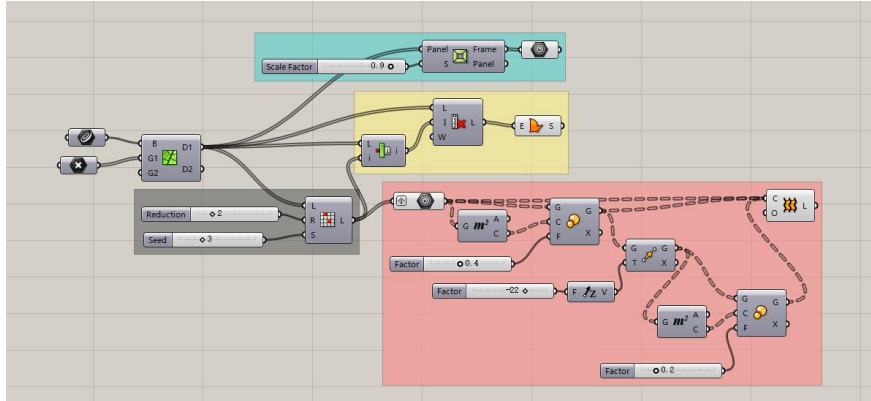
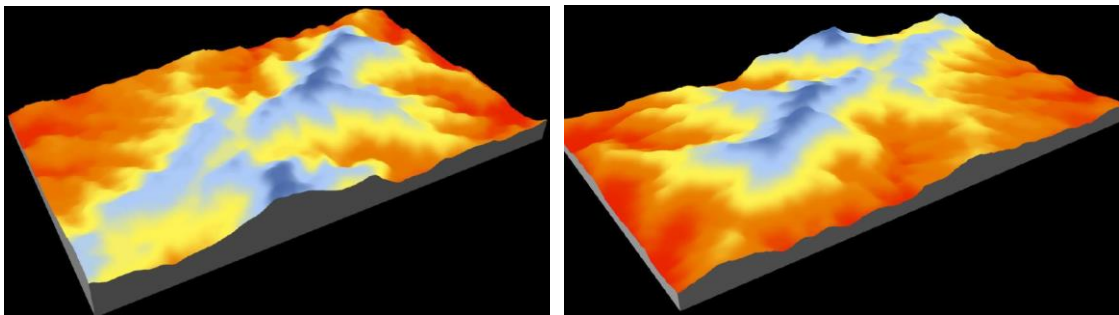


Figure 4: Construction of the logic of terrain elevation analysis.

Based on the logic construction and analysis principle of grasshopper, the terrain model of the scenic spot is imported into the logic system. From the figure, it can be seen that the highest elevation of Zhongshan scenic spot is 660 meters, and the lowest elevation is 58 meters. The range of elevation is displayed by the transition of color. The whole site is high in the South and low in the north, and the shape gradually decreases from the high scale of the center to the surrounding area, showing the geomorphic characteristics of convex terrain. Figure 5 shows the results of independent sample t-test for cognitive load.



(a) South

(b) North

Figure 5: Results of independent sample t-test for cognitive load.

4.2 Terrain Contour Analysis

The premise of terrain contour evaluation is to reap the terrain contour of the site. In the third chapter, the contour generated via importing the TIF structure picture downloaded from the terrain information cloud into world mapper may also now not totally replicate the terrain facts of the site, so it is integral to reconstruct the terrain contour. According to the traits of rhino and grasshopper, the writer located that there are two techniques to reconstruct the contour based totally on the institution of terrain model. Taking the terrain of scenic place as an example, the use of the common-sense building of grasshopper, the contour of terrain grid floor is generated by using inputting the interval value, this technique is appropriate for the floor of mesh structure, and the generated contour can be greater practical and smoother in accordance to the optimization of mesh surface. Figure 6 shows the construction of analysis logic of terrain contour.

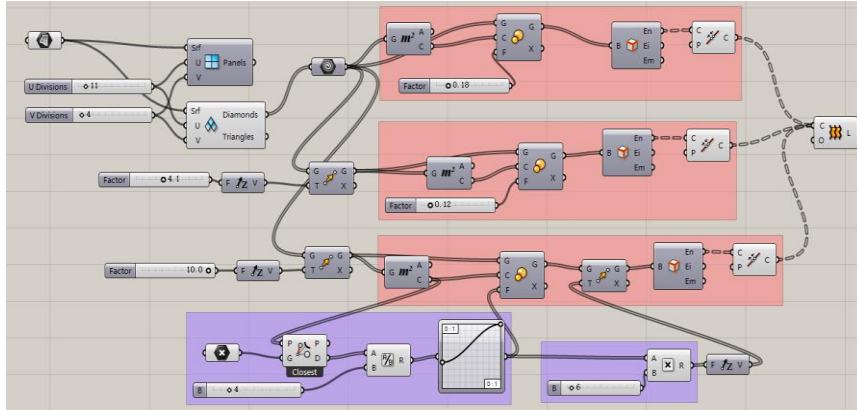
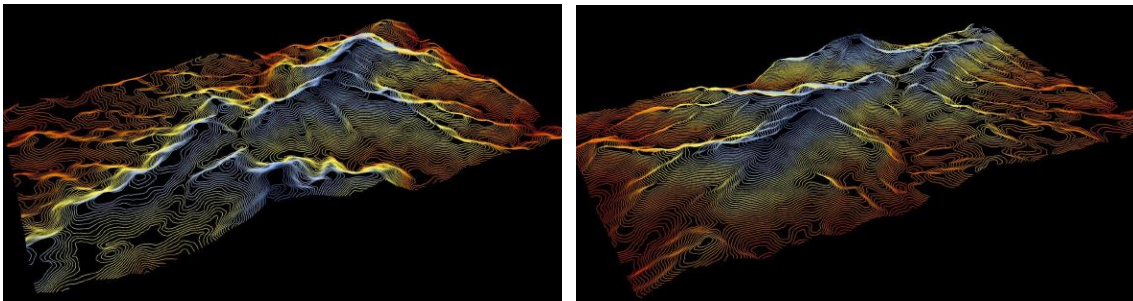


Figure 6: The construction of analysis logic of terrain contour.

Taking 10m as the contour spacing of Zhongshan scenic area, the contour lines are picked up and analyzed through logical construction. It can be seen from figure 8 that the highest contour line is 651m and the lowest is 61m. The elevation value is different from that in Figure 4.2, which is affected by the spacing value. However, the contour analysis itself is not consistent with the elevation analysis, Contour analysis expresses the situation of terrain type, while elevation analysis expresses the situation of terrain elevation. It can be seen from the contour map that the terrain of Zhongshan scenic spot is more complex, with flat land in the north and mountain peaks in the south. The three-dimensional effect map of the north and South can not only display the elevation of the terrain with layered colors, but also show the overall trend of the terrain. If you don't know enough about the terrain, you can also observe the terrain through the three-dimensional display map of rhino, which greatly facilitates the planning and design personnel to solve the problem of large terrain planning and design site investigation. Three-dimensional rendering of terrain contour analysis is shown in Figure 7.



(a) South

(b) North

Figure 7: Three-dimensional rendering of terrain contour analysis.

4.3 Output of Design Model

Taking the integration of landscape planning and design stage model and complex status quo as a case, based on the design drawings, the professional drawings are modeled and summarized; According to the requirements of various disciplines, BIM Technology is used to effectively coordinate the contradictions among landscape civil engineering, structure, water and electricity pipelines, greening and planting, and solve the problems that may occur in the construction process in advance. There is a problem with the accuracy of the Revit model at this stage. The

model accuracy required in the scheme, preliminary design, construction drawing and other stages should reach the level L350 accuracy to ensure that the accuracy of design components can meet the construction requirements. After that, the deepening work of the model can be continuously deepened by the construction unit according to the needs to meet the construction needs. In order to solve the difficult problem of current site modeling in landscape architecture project, the automatic modeling of current site is carried out by oblique photography and context capture. UAV equipment is used to capture flight data and complete multiple route shooting. After the completion of aerial photography, a total of 600 aerial photos were obtained. By importing the data into context capture, the aerial photos were automatically overlapped and the preliminary reverse modeling work was completed. Context capture software comes with a variety of data formats, including sob, FBX, obj, DAE, etc. the final output format of this case is sob, and the 3D model is finally established. Figure 8 shows the three-dimensional rendering of terrain contour analysis.



(a) Aerial view of a corner of the Pavilion



(b) Aerial view of the inner lake

Figure 8: Three-dimensional rendering of terrain contour analysis.

5 CONCLUSION

This paper combines the idea and technique of parametric format into landscape structure design, and places ahead appropriate techniques in accordance to the traits of landscape architecture. Firstly, the standards of parametric sketch and landscape structure parametric format are defined. On this basis, the idea, theoretical basis and technical basis of landscape architecture parametric design are combed, and the research progress of landscape architecture parametric design at home and abroad and the actual case application are summarized. Then, through the summary of ideas and cases, it leads to the framework of landscape architecture design method based on parameterization. Finally, this paper analyzes the specific application of landscape parametric design method, introduces the parametric design method of site selection and road design in landscape design in detail, and illustrates the application of parametric design in the early analysis, scheme conception and later adjustment of landscape design, it fully reflects the scientific and efficiency of landscape parametric design. The innovation of this paper lies in the mixture of parametric graph technique and panorama structure design, which enriches the ordinary planning and format techniques from extraordinary perspectives. Landscape structure plan is the integration of science and science and literature and art. In this paper, parametric design is introduced into landscape architecture, only in science and technology to try, less in literature and art, which is also the inadequacy of the article, I hope the future research can be supplemented.

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