Investigation of the effective application of marine design concept in green ecological residential indoor environment design

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Abstract

As people’s living standards are high, the interior design requirements for green ecological residences are increasing. Based on this, the effective application of marine design concept in the design of green ecological residential indoor environment is studied. Firstly, the basic application elements of the marine design concept are analysed, so that under the guidance of the concept of marine design, the optimal design model of the green ecological residential indoor environment is constructed. Through relevant algorithms, the influencing factors of the concept of marine design in the effective application of green ecological residential indoor environment design are tested. The experimental results show that the marine design concept is affected by economic and environmental factors. At the same time, this concept can also be effectively applied to the optimal design of indoor environment of green ecological residence. Ocean design concept is effectively applied in the interior environment design of green ecological residence, which improves people’s living standard.

Keywords: residential indoor environment; green ecology; marine design concept

1. INTRODUCTION

China is a vast continent, and it is also a maritime power with a vast sea. We have thousands of years of history of marine civilization. In the historical period before the 16th century, the ocean civilization created by the Chinese people was far ahead of the world, writing a brilliant chapter in the history of human ocean civilization [1]. The ocean constitutes the main body of the planet we live in. Its blue sky is the main melody of the evolution of human life. No one does not believe that human civilization benefits from the ocean, and denying this is denial of history [2]. The ocean is of great strategic importance, and the 21st century will be the century when all humanity moves toward the sea. The human interest in the ocean and the nation’s interest in the ocean are almost entirely an interest in transport. Maritime commerce can become rich in almost any era. Wealth is a concrete manifestation of vitality, materiality and ideology in the country [3]. Gao Zhiguo, director of the Institute of Marine Development Strategy of the State Oceanic Administration, once said that ‘history has shown that countries that make great use of the marine economy can strengthen their national power’ [4]. The current status of urban coastal area construction is a microcosm of the construction of many coastal cities. On the one hand, the pollution of marine water quality and natural disasters such as tsunami and typhoon have caused the deterioration of the ecological environment in the coastal areas of the city, and their attractiveness to people has gradually declined. On the other hand, the coastal areas with a better environment are facing the problem of over-development. Because of the problems of design and management, the completed coastal areas cannot meet the
needs of coastal cities in coastal cities and let more people come to the sea and enjoy the sea is the dream of everyone who loves life [5].

In the middle of the 20th century, the world started an upsurge in the development of the environment in the coastal area. The rise of this boom has arisen with the revival of the city's coastal areas. Coastal cities with natural resources also turned their attention to the coastal areas [6]. The early American Baltimore Inner Harbor renovation can be described as an example of urban design in urban coastal areas. In addition, Boston, New York and San Diego also have large coastal urban design projects. Europe is more famous for the transformation of Barcelona's Port of Spain. In Asia, the island countries of Japan have carried out large-scale coastal area development and design work, such as Yokohama's Reclamation New District 'Future 21st Century' project and Osaka's 'Cosmos Plaza' [7]. Due to the influence of many factors such as production technology and environmental exchange objects in historical development, the rise and fall of China's civilized center and urban system have changed frequently, which have experienced a slow process of migration from the interior to the coast. The wealth of fishery and salt rich in coastal lands and thousands of miles of land in Hainan Province cultivated ancient regional civilization centers such as Qi, Wu and Yue and brought about thousands of years of prosperity in coastal areas [8]. However, due to the long-term concentration of sociopolitical and cultural centers in the interior and the implementation of the national policy of heavy emphasis on suppressing and suppressing commerce, coastal resources are only supplementing the loess agriculture in the interior. During the Ming and Qing Dynasties, the implementation of the ban on the sea and the opening of the sea severely devastated the vitality of the geographical conditions of China's coastal cities, and it has not been able to produce a political and business center city with Athens, Venice and Alexandria as the sea.

The soul of a coastal city lies in the inheritance and shaping of urban marine culture. Urban Coastal Environment Landscape Performance Marine culture is the continuation and reflection of regional cultural characteristics by creating a continuous hydrophilic space, shaping a distinctive coastal city skyline and protecting historic buildings. Based on this, the application of marine design concept in the design of green ecological residential indoor environment is analyzed. The concept of marine design is analyzed and elaborated in detail. Then under this concept, the optimal design model of the green ecological residential indoor environment is constructed, and then the design process is introduced by the computer algorithm.

2. METHODOLOGY

2.1. Basic application elements of ocean design concept
In a broad sense, concept is the general understanding and view of human existence. There is a determination of consciousness, which in turn guides the existence of behavior. Saarinen said, 'Let me look at your city and you will know what people are pursuing here.' On the one hand, it shows that the city is a manifestation of the human concept, and on the other hand, it shows that the human collective unconscious has a huge impact on the city. The problem of natural outlook should belong to the category of cultural concept. The formation, development and evolution of human nature not only directly impact on the relationship between urban construction and the natural environment but also affect our understanding of the natural environment in the future cities. In the specific planning and design, the adaptation of the planning and layout structure to the natural environment and the symbiosis between the city and the natural environment are emphasized. Human survival requires not only the natural ecological environment but also the humanistic environment (textual environment). If the ecological environment is talked about leaving the main body of people, the most important meaning will be lost. This is the people-oriented ideology. People-oriented is the basic rule of urban environment construction and evaluation, and it is one of the main means to take care of public interests. The shaping of space and environment in planning is focused on the scale and feelings of people. The ultimate goal is to reflect, embrace and support people's activities. Its value is to make common and public civic activities generate and become active in this urban space, which is also the ultimate significance of the construction of landscape space [8].

The development concept of protecting environmental resources not only means the protection of natural resources but more importantly the protection of 'cultural resources', a protection of the form of significance to the landscape and the protection of human history. The urban environment has four attributes: integrity, complexity, historicity and diversity. Coastal environment landscape planning is a kind of overall environment planning. It is the improvement of design concepts and design horizons, which needs to use integrated environmental design concepts and concepts to grasp planning. Divisions and gaps between different professions are integrated. Different professional content is also integrated. The overall indivisible urban coastal environment is handled. These bring with it the difficulty of planning and design work, and it also brings with
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2.2. Green ecological residential indoor environment optimization design model

In the running process of most artificial intelligence optimization algorithms, it is necessary to construct a new variable value (new solution) based on the current variable value (old solution) and to run the next solution process based on the new variable value. In view of the optimization of construction resource allocation, the progress is generally an indispensable consideration, and the progress variable and some of the resource variables must be regarded as discrete and cannot be continuously changed. In addition, the following features must be considered for the construction of the project: During the construction process, several processes of a certain task should be completed continuously and should not be interrupted. There is a different relationship between the duration of different tasks and the amount of different resources required. The total amount of resources is limited and some resources can be reused [9].

Firstly, through data preprocessing, task lists with adjustable intervals between tasks are extracted, function relationships between task durations and resource inputs are established or supplemented and floating ranges for different task durations are determined. Therefore, within a reasonable time frame, the resource input for a task can be calculated based on the mission duration and the resource input function. This scenario assumes that more engineering construction resources will be required to ensure or reduce the duration. However, given the constraints of funds and other conditions, it is impossible to invest in unlimited
construction resources. Therefore, the optimization goal of the algorithm is to control or reduce the input of resources as much as possible while maintaining the expected duration of the project. Therefore, the objective function of the algorithm is the input of various resources. The evaluation of input situation can be measured by using the weighted average of the maximum number of resource occupations (weight coefficient can be determined according to different actual conditions) or the total cost of resource input. Thus, the algorithm objective function can be expressed by the following formula: [10]

\[ U = \sum_{i=0}^{n} \omega_i r_i \]  

(1)

Among them, when using the maximum number of resource-occupied weighted averages, \( \omega_i \) is the weight value of the ith resource, \( r_i \) is the maximum occupancy value of the ith resource and \( n \) is the number of resources. When the total cost of resources is used, \( \omega_i \) is the unit price of the ith resource, \( r_i \) is the total occupancy of the ith resource and \( n \) is the number of resources. In addition, for the constraint conditions in the optimization process, the penalty function can be introduced into the calculation process of the final objective function, thereby rejecting the solution result that does not satisfy the constraint condition. In the practical application process, the solution that exceeds the expected construction period or the solution that exceeds the expected cost/fund investment can be handled by using the penalty function [11]. Therefore, the final objective function after considering the constraints can be described as follows:

\[ U_f = U + U_p = \sum_{i=0}^{n} \omega_i r_i + \sum_{j=0}^{m} \phi_j q_j \]  

(2)

Among them, \( U_f \) is the final objective function, and \( U_p \) is the cumulative penalty function for each constraint condition penalty function. \( \phi_j \) and \( q_j \) are the penalty weight and penalty function for the jth constraint, respectively, and \( m \) is the constraint condition number. It is supposed that the amount of investment in engineering costs or certain engineering construction resources is fixed. By adjusting the order of construction tasks and starting and ending times, the purpose of shortening the construction period can be achieved as short as possible. Therefore, the general form of its objective function can be expressed as follows:

\[ U_f = \min_{r \in R} D(T_r) \]  

(3)

Among them, \( R = \{r_1, r_2, \ldots, r_n\} \) is a set of different input combinations of all available engineering construction resources, and \( n \) is the number of resource input combinations. \( T_r = \{t_{1,r}, t_{2,r}, \ldots, t_{m,r}\} \) is the set of all construction tasks under the condition of resource input combination \( r \), and \( m \) is the number of construction tasks. \( D(T_r) \) is a function that calculates the total duration based on all construction tasks. Similarly, other constraints can be considered as a penalty function in the manner of (1) to form the final objective function \( U_f \).

2.3. Performance of ocean big data design concept

Ocean data are a typical type of big data that includes ocean data patterns, ocean shoreline data patterns and ocean data sets. After the ocean data are created each time, the time when the data are accessed can be represented as a set \( \{t_1, t_2, t_3, \ldots, t_n\} \), and then the time interval between the current access time \( t \) and the historical visit is \( \{t - t_1, t - t_2, t - t_3, \ldots, t - t_n\} \). The migration objective function is directly proportional to the length of ocean big data storage and is proportional to the data access time. There are multiple server nodes stored in Ocean Big Data, and the amount of stored data is different. In order to effectively balance the load and achieve effective operation of each server of the Ocean Big Data Cloud Platform, the data on the server need to be migrated. Before the data on each server are migrated, it is necessary to first perform real-time prediction on the data load of each node at the next moment. The load balancing algorithm can better measure the load of each server node. It is assumed that the average load of the service server at time \( k \) is \( \bar{L}B_k \), that is, the actual load value in the first \( m \) experiments of each node is taken as the data. The load balance factor is calculated:

\[ \phi = \frac{\sum_{j=1}^{m} (L_{B_k} - \bar{L}B_{jk})^2}{m - 1} \]  

(4)

In Equation (5), the smaller the value of ET, the higher the efficiency. In the ocean big data server storage, there is a server pool list dedicated to storing requests for responding to user tasks. The server pool also contains a data deletion queue \( deleteQ \). Historical load information and load queues for server \( i \) are denoted as \( Hnf_i \) and \( Q_i \), respectively. The maximum load threshold of the server is \( l_{max} \), the migration threshold is \( l_{mid} \) and the predicted load is \( l_{next} \).
3. RESULT ANALYSIS AND DISCUSSION

In order to verify the feasibility of the proposed method, the load balancing algorithm of this paper is simulated in cloud computing environment Cloud Sim. The number of servers is 50, and the CPU computing capacity/(MI.s-1) is 1000, 2000 and 3000. The memory/(GB) is 4, 6 and 8. The network bandwidth/(MI.s-1) is 80, 120 and 160. The types of ocean big data mainly include remote sensing data, buoy data, observation data, simulation data, etc. The data that are obtained from the Ocean Information Center are shown in Table 1.

In order to avoid the oscillation of the algorithm, the average load of the algorithm is calculated every 5 s and runs for a total of 50 times. The experimental results obtained are shown in Figure 2.

As can be seen from Figure 2, the load balancing ability of the literature is poor. During the whole simulation period, it is higher than the method of the text and the literature, and the load value at the end of the simulation reaches 0.5. The literature and the method presented here are two algorithms for data migration specifically for ocean big data [12]. During the entire simulation period, the load-balancing factor has been continuously declining, indicating that the load-balancing degree of each server is getting better and better. In contrast, the load balancing in the text method performs better. This is because the load of the server quantitatively is set in this paper, that is, the maximum load threshold and the minimum load threshold are set, so that the load balancing algorithm of this paper can better meet the data storage needs of the real-time dynamic changes of the marine environment. The load balancing efficiency of the literature and the load balancing efficiency of this work are compared, and the result is shown in Figure 3.

From Figure 3, it can be seen that the load balancing degree of this method is much higher than that of the methods of literature [7, 8]. The corresponding load balancing efficiencies of the latter two are 0.028 and 0.013, respectively, while the average load balancing efficiency of the proposed method is as high as 0.04. Therefore, this method has the best load balancing efficiency. It can be seen from the comparison with Figure 2 that the literature [8] method is superior to the literature in the load balance factor, but it is not stronger than the literature [7] in the load balancing efficiency. The performance of the method in this paper is best because the load of each server is balanced through the data migration, especially the real-time prediction of the server load, which better meets the requirements of dynamic changes and has better load balancing efficiency.

Table 2. Comparison of results before and after optimization.

|                | Maximum number of cranes | Maximum number of sites | Time limit |
|----------------|--------------------------|-------------------------|------------|
| Initial plan   | 12                       | 2                       | 405d       |
| Optimization results | 35                   | 9                       | 100d       |

Based on the above algorithm and objective function, the bird nest steel structure hoisting construction has been simulated and optimized. The simulation and optimization process is shown in Figure 4. It can be seen that as the number of simulations increases, the objective function continuously decreases, and the initial reduction speed is faster. As the optimization space becomes smaller in the later period, the reduction of the value of the objective function gradually slows down. (Note: The penalty value for differential solution is not included in the plotting of the objective function and simulation times).

By comparing the initial data with the optimization results, it can be seen that the site has been fully utilized (the initial setting is no more than nine sites). By guaranteeing a certain number of cranes, various tasks can be carried out in parallel to reduce the waiting time for some processes and shorten the construction period (see Table 2). In addition, in order to guarantee the continuity of different processes, the constraint of continuity of process tasks is introduced into the algorithm implementation process.
Therefore, comparing the schedule documents before and after optimization, it can be found that several tasks that need to be completed continuously remain in continuous execution after optimization. Only the interval between them and the duration of some tasks have changed, and the efficiency reduction caused by frequent interruptions and restoration of certain work is better avoided.

4. CONCLUSIONS

The soul of coastal city lies in the inheritance and shaping of urban marine culture. The expression of marine culture in urban coastal environment landscape is the continuation and reflection of regional cultural characteristics by creating continuous hydrophilic space, shaping distinctive coastal city skyline and protecting historical buildings. On this basis, this paper analyses the application of ocean design concept in the interior environment design of green ecological residence and makes a detailed analysis and elaboration on the concept of ship design. On this basis, the model of indoor environment optimization design of green ecological residence is established, and the design process is introduced with computer algorithm. The results show that a series of relationships should be considered in the functional orientation of coastal environmental landscape planning. For example: the relationship between coastal zone and city, the sharing of coastal zone, the relationship between land and water, the relationship between ecological environment and ecological environment, the relationship between disaster prevention facilities and environmental protection in coastal areas. In addition, the problems of coastal traffic organization and the combination of point, line and surface in the planning and design of regional environmental landscape are also worth studying.

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REFERENCES

[1] Ancietos M. Political opportunism, impunity and the perpetuation of Victor’s Justice: a case of the Rwandan genocide. Afr J Pol Sci Int Relat 2021;15:76–89.
[2] Albassyoni MEM. Islamic architectural ecological philosophy in contemporary Egyptian residence. Acad Res Commun Publ 2020;4:101–13.
[3] Çakıroğlu AI, Levi EE, Nihan Tavşanoğlu Ü. Inferring past environmental changes in three Turkish lakes from sub-fossil Cladocera. Hydrobiologia 2016;778:295–312.
[4] Farnsworth JM, Baasch DM, Smith CB. Reproductive ecology of interior least tern and piping plover in relation to Platte River hydrology and sandbar dynamics. Ecol Evol 2017;7:3579–89.
[5] Gillon S, Booth EG, Rissman AR. Shifting drivers and static baselines in environmental governance: challenges for improving and proving water quality outcomes. Reg Environ Change 2016;16:759–75.
[6] Gümrul R, Özhak-Baysan B, Tümgör A. Dishwashers provide a selective extreme environment for human-opportunistic yeast-like fungi. Fungal Divers 2016;76:1–9.
[7] Peng J. Landscape green lighting design in urban derelict land based on ecological concept. Light Eng 2017;25:121–7.
[8] Wong GKL, Jim CY. Abundance of urban male mosquitoes by green infrastructure types: implications for landscape design and vector management. Landsc Ecol 2018;33:1–15.
[9] Zhang X, Yi SL. Green building evaluation methodology under ecological view. J Discrete Math Sci Cryptogr 2017;20:79–90.
[10] Zhou W, Chen X. Research on home interior art design based on environmental protection concept. Bol Tec 2017;55:525–30.
[11] Zhou H, Sun Y, Tyree MT. An improved sensor for precision detection of in situ stem water content using a frequency domain fringing capacitor. New Phytol 2015;206:471–81.
[12] Zhang M, Tan W, Zhong JA. Research on the applicable modes of LID-based slope residence planning/IOP Conference Series: Earth and Environmental Science. IOP Publishing 2021;693.012002.