Analysis of Measures for Integrating Ecological Concepts into Landscape Design and Construction

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Abstract: In the context of globalization, ecological and environmental protection has received significant attention from countries worldwide, making the integration of ecological concepts into landscape design and construction a hot topic. This paper provides a detailed analysis of how ecological concepts can be incorporated into all aspects of landscape design and construction, proposing specific measures aimed at offering ecological guidance for landscape design and construction, accelerating the green development of the landscape industry, and achieving the goal of harmonious coexistence between humans and nature.

1. Introduction

With the accelerated pace of urbanization, landscape, as an important component of the urban ecosystem, has undergone profound changes in its design and construction concepts. Traditional landscape construction overly pursued ornamental value, neglecting ecological balance and contradicting sustainable development requirements. The integration of ecological concepts is not merely a technical addition but involves reconstructing a dialogue between humans and nature from the design source. It requires reasonable design of circulating water features and scientific plant combinations based on respect for the original ecological foundation of the site, meeting the living needs of urban residents while improving the ecological chain and effectively regulating the urban microclimate. Currently, how to integrate ecological concepts into specific landscape design and construction is a hot topic in the transformation of the landscape industry.

2. Principles to Be Followed When Integrating Ecological Concepts into Landscape Design and Construction

2.1 Principle of Adaptation to Local Conditions

The principle of adaptation to local conditions is the core when integrating ecological concepts into landscape design and construction. It focuses on deeply integrating landscape construction, site natural conditions, and regional characteristics to avoid designs and constructions that are detached from reality. During the landscape design phase, this principle requires a comprehensive exploration and utilization of the original ecological features of the construction site. For example, in landscape design in arid regions of northern China, water-collecting terrain should be applied, and cold-resistant plants such as sea buckthorn should be prioritized. In landscape design in southern China, natural slopes can be utilized to construct rainwater drainage systems, with plants like calamus being prioritized. During the landscape construction phase, this principle requires efficient handling of site resources. For example, waste stone materials on the construction site can be processed into landscape ornaments to reduce the quantity of externally purchased materials and lower carbon emissions. Additionally, the construction schedule should be synchronized with the regional climate rhythm, such as conducting underground pipeline construction during the plum rain season in southern China to avoid surface erosion by rainwater. In essence, the principle of adaptation to local conditions makes landscape a vital support and extension of the site's natural ecosystem, representing the concretization of ecological concepts.

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2.2 Principle of Aesthetic and Practical Integration

The principle of aesthetic and practical integration requires that in landscape design and construction, while showcasing the ecological value of the landscape, visual aesthetics should be enhanced to avoid the phenomenon of "ecology for the sake of ecology." At the design level, this principle requires the harmonious unity of ecological elements and humanistic needs. For example, when using native plants to construct landscapes, reasonable design of seasonal changes and scientific color combinations can create a good visual effect. In autumn, golden torch trees and ginkgo trees can be paired to create an atmosphere, meeting citizens' aesthetic demands for landscapes while leveraging the ecological advantages of native plants. When designing functions, specific usage scenarios should be considered. For example, in community landscapes, ecological lawns and rest platforms can be organically combined, with bamboo and wood materials being used for the platforms and zoysia grass for the lawns, providing high-quality activity spaces for residents while achieving the goals of being visitable and appreciable through natural space separation. At the construction level, this principle requires that craftsmanship details and ecological goals complement each other. For example, in the construction of ecological embankments, attention should be paid to both ornamental value and stability. When stacking blocks, appropriate gaps should be retained to create favorable conditions for the rooting of aquatic plants and to create a natural and wild space through the contrast in textures between plants and stones. In the construction of garden paths, permeable bricks can be laid following the natural terrain, enhancing water permeability while reducing the stiffness brought by hard paving, making functional facilities an indispensable part of urban landscapes. In essence, the core of the principle of aesthetic and practical integration is to enable the public to perceive ecological concepts through landscape forms, making landscape beauty pleasing the public's senses and achieving both ecological and social values of the landscape.

2.3 Principle of Rational Combination

The principle of rational combination emphasizes the construction of a functional ecological system through scientific combinations of various elements in landscape design and construction, ensuring interconnections among elements. When combining plants, symbiotic communities should be reasonably constructed by combining plants based on their ecological niche differences. For example, deep-rooted trees and shallow-rooted shrubs can be paired, with deep-rooted trees absorbing nutrients from deep soil layers and shallow-rooted shrubs utilizing surface soil resources to avoid nutrient competition. Attention should also be paid to the mutual promotion and restraint relationships among plants during plant combinations. When combining biological elements, attention should be paid to the balance among producers, consumers, and decomposers [1]. In the design of water features, appropriate combinations of aquatic plants as producers can be made to provide oxygen to the water body, and fish as consumers can be introduced to control the excessive proliferation of algae. Additionally, earthworms as decomposers can be introduced to achieve ecological circulation. In essence, the principle of rational combination makes each element in the landscape an important node in the ecosystem. By effectively coordinating different elements, it can not only amplify the ecological benefits of individual elements but also enhance the ecological stability of the landscape.

3. Measures for Integrating Ecological Concepts into Landscape Design

3.1 Respect the Original Ecology of the Site and Implement Scientific Planning

Respecting the original ecology of the site and implementing scientific planning is the primary step in integrating ecological concepts into landscape design. The core of this step is to comprehensively combine artificial interventions with natural ecology based on the site's natural foundation. In the early design stage, staff need to conduct systematic surveys, using methods such as drone aerial photography and biodiversity surveys to understand information such as actual hydrological directions, the distribution of original vegetation, and terrain slopes. For example,

specific protection ranges can be delineated for ancient trees on the construction site, prohibiting construction within these ranges. For seasonal streams, detailed records of their water level changes, high-water periods, and low-water periods should be made to provide necessary references for subsequent landscape design. During specific planning, staff should follow the principle of "minimum intervention" and focus on retaining the original ecological elements on the construction site. For naturally formed slopes, terraced flower beds can be designed following the slope to reduce earthwork while reasonably utilizing terrain to collect rainwater. Wild herbaceous plants on the construction site should not be completely cleared but scientifically combed to retain their best community forms and scientifically combine native shrubs to create high-quality natural vegetation landscapes.

3.2 Rationally Combine Plants and Construct Stable Plant Communities

In landscape design applying ecological concepts, the key to rationally combining plants and constructing stable plant communities is to build a vegetation system with strong self-maintenance capabilities through scientific combinations of species. Native plants should be the premise in design, and original species adapted to the local climate and soil conditions should be selected. For example, in northern China, trees such as koelreuteria paniculata can be selected, paired with shrubs such as lonicera maackii, and the ground cover layer can be centered around potentilla chinensis. After a period of growth, these plants will develop strong stress resistance, reducing artificial maintenance costs [2]. Meanwhile, the proportion of alien species should be controlled within a reasonable range, and the safety and ecology of introduced alien ornamental species should be evaluated to avoid biological invasions. When designing community structures, the principle of complex mixed layers should be followed to construct three-dimensional landscapes integrating trees, shrubs, herbs, and vines. Tall trees with shading functions can be selected for the upper layer, semi-shade-tolerant shrubs with rich community layers for the middle layer, and ground cover plants covering the surface for the lower layer. This structure can improve the quality and occupancy rate of high-energy light utilization. Additionally, ecological relationships among plants should be considered in plant combination design to avoid species competition. For example, rosemary and mint can be planted around plants of the Rosaceae family to reduce the breeding of aphids and other pests. Meanwhile, differences in plant phenological periods should be considered to enhance the continuity of translated as "four-season" landscapes.

3.3 Design Ecological Water Features and Achieve Water Resource Circulation and Utilization

Designing ecological water features and achieving water resource circulation and utilization are important practical paths in landscape design combining ecological concepts. The core is to construct a complete system integrating natural purification, circulation and utilization, and ecological symbiosis. When designing ecological water features, the hardened mode should be changed, and a near-natural layout strategy should be applied [3]. Ecological embankments can be constructed using pebbles and logs to provide breeding sites for aquatic organisms such as dragonflies and to prevent soil erosion with the help of plant roots. For example, when designing water features in residential areas, the embankment can be designed as a gentle slope with a slope ratio of 1:3, and emergent plants such as typha can be planted along the shore, with submerged plants such as hydrilla verticillata arranged underwater to construct a three-dimensional ecological belt and fundamentally improve the water body's purification capacity. To effectively maintain water quality, benthic organisms such as mussels can be appropriately introduced, and a layer of volcanic rock about 13 centimeters thick can be laid at the bottom of the water body to provide attachment carriers for microorganisms. Meanwhile, plants such as cyperus alternifolius can be planted to absorb nutrients such as nitrogen and phosphorus through their roots to control the outbreak of blue-green algae [4]. Additionally, in the design of water circulation systems, collection, purification, and reuse chains should be integrated. Rainwater gardens and other sponge facilities can be set up around water features to collect road surface rainwater and roof rainwater, which can then be filtered and used to replenish the water features.

4. Measures for Integrating Ecological Concepts into Landscape Construction

4.1 Use Environmentally Friendly Materials and Reduce Construction Pollution

In landscape construction, using environmentally friendly materials to reduce construction pollution is a necessary step in practicing ecological concepts, requiring the formation of a complete control system from material selection and application scenarios. In material selection, the principles of low consumption, recyclability, and non-toxicity should be followed. Building materials produced locally should be prioritized to reduce carbon emissions during transportation. Recycled materials should be actively applied, such as breaking construction materials into recycled aggregates for casting landscape ornaments, reducing the demand for landfilling waste and natural sand and gravel mining. Materials containing harmful substances should be prohibited, and bamboo fiber boards can be used instead of traditional plywood. Meanwhile, environmentally friendly materials should be selectively used in different construction links. Permeable materials such as grass-planting bricks with relatively high porosity should be prioritized for ground paving to help quickly infiltrate rainwater and replenish groundwater. Additionally, supporting measures should be implemented to effectively control pollution during material use. A material entry inspection mechanism should be established to sample and test indicators such as the harmful substance content of recycled materials. The "clean operation method" should be implemented during specific construction, such as using wet cutting for stone to reduce dust [5]. By-products generated during construction should be reused, such as crushing wood by-products into plant mulch to achieve ecological management of the entire material life cycle.

4.2 Apply Ecological Technologies and Reduce Ecological Impacts

In landscape construction, to effectively practice ecological concepts, targeted technical means should be used to minimize the interference of construction on the site's original ecosystem. In soil protection, layered stripping and original soil layer return technologies should be applied. Before construction, the soil should be stripped into a heart soil layer of about 40 centimeters and a topsoil layer of about 20 centimeters, and the stripped soil should be separately stacked and covered with non-woven fabrics for moisture and fertility preservation to avoid damaging the soil structure. During return, the soil layers should be laid in the original order, and an appropriate amount of biological amendments should be spread to accelerate the recovery of soil organic matter content. For compacted soil, aeration technology can be applied through mechanical perforation to improve the activity of soil microorganisms [6]. In plant protection technologies, the principle of minimum interference should be followed. For retained trees, a flexible support scheme should be used, wrapping the trunk with breathable non-woven fabrics and setting up protection circles around the tree roots. Materials should not be stacked or mechanical rolling should be prohibited within the circles. In water source protection, source irrigation + circulation and utilization technologies should be applied. Temporary rainwater collection ditches can be set up on the construction site, and the treated rainwater can be used for irrigating seedlings to reduce municipal water consumption. By applying these ecological technologies, the interference of construction on the site's ecosystem can be minimized, and ecological protection and landscape construction can be advanced simultaneously.

4.3 Strengthen Construction Ecological Management and Improve Resource Utilization Efficiency

Strengthening construction ecological management and improving the quality of resource utilization can provide necessary guarantees for the implementation of ecological concepts in landscape construction, requiring comprehensive control of resource consumption and ecological impacts through a complete management mechanism. In the early construction stage, staff need to formulate a refined ecological management plan, scientifically delineate ecologically sensitive areas based on site ecological assessment results, and reasonably set up electronic fences [7]. Clear resource consumption quota standards should be established, such as calculating the amount of irrigation water based on the seedling planting area and determining the stone loss rate according to

the paving area. Dedicated ecological inspection posts should be set up to regularly check the integrity of vegetation protection circles and the smoothness of temporary drainage systems. Once problems are found, they should be rectified within a specified time. Additionally, a complete resource recycling system should be constructed. Construction waste should be crushed and screened, with coarse aggregates being used for roadbed backfilling and organic fertilizers and sawdust being combined to make planting substrates [8]. Pruned branches should be crushed and used as mulch to reduce the growth probability of weeds. Meanwhile, mechanical scheduling plans should be optimized and improved, with new energy engineering equipment replacing traditional fuel-powered equipment and construction operation times being centrally arranged to reduce invalid energy consumption and improve resource utilization quality.

5. Conclusion

In conclusion, integrating ecological concepts into landscape design and construction is an inevitable trend of the times. In practical applications, designers and constructors should focus on the details of implementing ecological concepts, optimize construction plans according to actual climatic characteristics and cultural conditions, and conduct scientific planning to improve the level of urban ecological environment construction.

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