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# Research on Plant Configuration and Planning in Landscape Architecture Design

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**Abstract:** Plants constitute the core element of landscape architecture design, with their arrangement and planning directly determining a garden's ecological functions, visual impact, spatial ambiance, and sustainability. Against the backdrop of ecological civilization development and urban refinement, plant configuration has evolved from traditional visual enhancement to an integrated approach prioritizing ecological integrity, multifunctionality, regional adaptability, and long-term low-maintenance performance. This paper systematically examines the theoretical foundations, fundamental principles, functional values, artistic techniques, spatial design, and maintenance strategies for plant configuration and planning. Through practical analyses across diverse settings—including ecological restoration, urban parks, residential areas, waterfront green spaces, and rural landscapes—it identifies current challenges such as homogenized designs, excessive emphasis on aesthetics at the expense of ecology, short-term gains over sustainable benefits, and insufficient use of native species. The study proposes scientific, localized, ecologically sound, and user-centered optimization pathways, providing theoretical support and practical guidance for enhancing landscape design quality and advancing green, low-carbon urban development.

**Keywords:** Landscape architecture; Plant configuration; Plant planning; Ecological landscape; Native plants; Spatial design

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## 1. Introduction

Plants serve as the lifeblood of landscape architecture, acting as a vital bridge connecting nature and urban spaces, ecology and human culture, functionality and aesthetics. Plant configuration and planning are not merely about piling up seedlings, but rather a systematic endeavor that involves scientifically selecting, rationally arranging, artistically combining, and implementing long-term management of trees, shrubs, ground covers, vines, and aquatic plants based on site characteristics, climatic conditions, soil environments, functional requirements, and cultural features<sup>[1,2]</sup>.

As urban ecological challenges become increasingly prominent, the ecological value of landscape plants in carbon sequestration and oxygen release, temperature regulation and humidity enhancement, water conservation, air purification, noise reduction, and biodiversity maintenance has garnered significant attention. Meanwhile, residents' demands for the healthiness, comfort, cultural richness, and participatory nature of landscape spaces continue to rise<sup>[3,4]</sup>. The traditional approach of "large lawns, expansive color blocks, and dense planting" has gradually revealed its drawbacks: high costs, substantial maintenance requirements, poor ecological performance, and limited adaptability<sup>[5]</sup>.

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Therefore, conducting scientific and systematic research on plant configuration and planning to achieve the integration of ecological benefits, landscape benefits, social benefits, and economic benefits is an inevitable requirement for the high-quality development of the landscape architecture industry in the new era<sup>[6]</sup>. It also serves as a crucial foundation for building livable cities, resilient cities, and low-carbon cities<sup>[7]</sup>.

## **2. The Fundamental Concepts and Theoretical Basis of Plant Configuration and Planning**

### **2.1. Definition of Core Concepts**

Plant planning involves comprehensive coordination of the plant structure, species selection, proportional relationships, layout configuration, and seasonal characteristics of garden green spaces; plant configuration refers to the detailed design of specific plant combinations, planting methods, spatial forms, and layer arrangements within the planning framework. These two aspects complement each other and collectively constitute the core system of landscape plant design.

Plant planning emphasizes strategic deployment at the macro level, requiring alignment with higher-level planning frameworks such as urban master plans and green space system designs. It defines objectives for plant community structures across different green spaces (e.g., parklands, protective green spaces, and ancillary green spaces), specifies the proportion of native plant species, establishes ecological function orientations, and identifies cultural thematic positioning to provide a systematic framework and scientific basis for subsequent plant configuration. Plant configuration, on the other hand, focuses on micro-level implementation. Guided by planning principles, it integrates various life-form plants—including trees, shrubs, ground covers, and vines—based on site-specific conditions (e.g., light intensity, soil pH, moisture status), spatial scales, and functional requirements. Through meticulous design of plant spacing, community stratification, color coordination, and seasonal variations, this approach creates plant spaces that combine ecological functionality, landscape aesthetics, and cultural significance.

### **2.2. Main Theoretical Foundations**

Landscape ecology theory emphasizes the spatial structure of patches, corridors, and substrates, focusing on plant community stability, ecological connectivity, and biodiversity conservation. In landscape planning and configuration for garden plants, this theory guides us to view urban green spaces as an organic whole composed of diverse plant patches (such as shrubs of varying sizes, lawns, and flower beds), ecological corridors (linear plant communities arranged along roads, rivers, railways, and other linear spaces), and substrates (dominant vegetation types in cities like urban forests and large green areas). By strategically planning patch size, shape, and distribution, we ensure suitable habitats for diverse organisms and maintain community stability. Simultaneously, constructing interconnected ecological corridors breaks down urban landscape fragmentation, facilitates species migration and gene exchange, and enhances ecosystem connectivity. Optimizing substrates further improves the overall ecological functions and biodiversity levels of landscapes, enabling garden plant systems to not only provide aesthetic value but also play crucial ecological roles such as regulating microclimates, purifying air, and conserving water resources.

Plant community ecology theory simulates natural plant community structures to establish multi-layered, mixed, stable, healthy, and low-intervention near-natural plant communities. Seasonal aesthetics theory utilizes the temporal variations of plants—spring blossoms, summer shade, autumn colors, and winter forms—to create dynamic landscapes with ever-changing scenery throughout the four seasons. Environmental adaptability theory adheres to the principle of “right trees for right places,” prioritizing native species and stress-resistant plants to ensure healthy growth and long-term survival. Human habitat theory focuses on psychological behavior patterns, visual perception, and health needs to achieve human-centered, comfortable, and safe plant spaces.

### **3. Fundamental Principles of Landscape Plant Configuration**

Prioritize ecological considerations, select appropriate tree species for specific sites, and give preference to native tree species and plants with strong adaptability. Fully account for site conditions such as light, moisture, soil, and climate to ensure plant survival and healthy growth. Achieve diverse layering with a rational structural composition.

Establish a multi-layered structure comprising “tall trees + sub-tall trees + shrubs + ground cover + herbaceous plants” to enhance green coverage and ecological benefits, thereby forming a stable plant community.

Seasonal variations are implemented with temporal equilibrium, incorporating the four-season landscapes to highlight spring blossoms, summer dense shade, autumn foliage, and winter branches, avoiding a scenario where scenery exists in one season while remaining barren in others. The design features clear primary and secondary elements, balanced density, prominent focal trees, harmonious supporting trees, and spatial arrangements with both open and enclosed areas as well as voids and solids, creating a sense of rhythm and harmony.

The design integrates multifunctional elements with human-centric principles, strategically arranging plants to meet diverse spatial needs including shading, rest, aesthetics, recreation, and ecological protection. Attention is given to the scale and visual harmony of plant spaces, creating comfortable activity areas through enclosure, partitioning, and directional guidance. Adopting low-cost, low-maintenance, and sustainable approaches, priority is given to plant species with vigorous growth, strong pest resistance, and minimal maintenance requirements to reduce long-term management costs. The design prioritizes native species while incorporating locally adapted exotic plants to establish self-sustaining communities that promote natural ecosystem cycles and stable development.

The design integrates multifunctional elements centered on human needs, providing comprehensive solutions for shading, dust control, noise reduction, fire prevention, isolation, rest areas, recreational activities, and public education, tailored to diverse user requirements. With low cost, minimal maintenance, and sustainable features, it eliminates the need for expensive seedlings, off-season planting, and water-intensive lawns, significantly reducing long-term maintenance costs while enhancing landscape durability. By incorporating regional botanical culture, historical context, and local traditions, the design creates distinctive localized plant landscapes that preserve cultural heritage and regional identity.

## **4. Functional Value of Plant Configuration in Landscape Architecture**

### **4.1. Ecological Environment Functions**

Improving urban climate: providing shade and cooling, increasing humidity, and mitigating the heat island effect. Purifying air quality: absorbing harmful gases, capturing dust, and releasing oxygen. Hydrological regulation: intercepting rainwater, conserving water resources, and controlling soil erosion. Supporting biodiversity: providing habitats for birds and insects, and establishing urban ecological networks. Carbon sequestration and reduction: enhancing the carbon sink capacity of urban landscapes, contributing to the achievement of the “dual carbon” goals.

Furthermore, plant configuration plays a crucial role in soil improvement. The growth and activity of plant roots help loosen soil structure, increase porosity, and enhance aeration and water permeability. Meanwhile, decaying plant litter decomposes into humus through microbial activity, effectively boosting soil fertility and improving its physicochemical properties, thereby creating favorable conditions for other organisms to survive and thrive. In polluted areas, specific plant species can also absorb, degrade, or immobilize harmful substances like heavy metals in the soil, performing ecological remediation functions and gradually restoring soil health.

### **4.2. Spatial Creation Function**

Spatial Partitioning: Utilize green walls, hedges, and dense forests to delineate areas and guide visual flow. Enclosed Spaces: Create diverse spatial configurations including open, semi-open, enclosed, and covered environments. Softening Hard Landscapes: Smooth out abrupt lines of buildings, roads, plazas, and structures. Skyline Enhancement: Establish

staggered heights to form elegant tree canopies, elevating urban aesthetics.

**Guiding the Tour Route:** Through the varying density of plant communities, color transitions, and seasonal changes, visitors' gaze is naturally guided to connect different scenic spots, creating a rhythmic and harmonious touring experience. For example, planting rows of trees along garden paths creates a framed landscape effect, enhancing spatial depth and directionality; distinctive plant clusters at turning points encourage visitors to pause and admire the views, naturally guiding their path. **Organizing Activity Spaces:** Planting configurations are tailored to meet diverse activity needs. Low shrubs around open lawns provide semi-private rest areas ideal for picnics and sunbathing; non-prickly, non-toxic plants paired with vibrant flowers in children's play areas foster a lively and engaging environment; ornamental trees and flowering shrubs around cultural event squares offer shade while enhancing the atmosphere, meeting spatial requirements for gatherings and performances.

### **4.3. Artistic Aesthetic Function**

**Color coordination:** Leaf hues, floral tones, and fruit colors create vibrant visual effects. **Morphological contrast:** Height differences, size variations, curvature patterns, and density arrangements establish rhythmic harmony. **Texture combinations:** Rough and refined surfaces, substantial and delicate textures enhance dimensional depth. **Dynamic landscapes:** Wind-swept swaying, shifting light and shadow, and seasonal transitions form captivating motion.

**Atmospheric Creation:** Through the ingenious integration of plants with landscapes, architecture, and decorative elements, landscapes are imbued with specific cultural connotations and emotional ambiance. For instance, the pairing of pine, bamboo, and plum blossoms often evokes the resilient and noble spirit of the "Three Friends of Winter," while the combination of lotus flowers and leaves conveys the refined elegance of "rising from the mud yet remaining unstained." This allows visitors to experience emotional resonance and cultural associations while appreciating botanical scenery. **Spatial Composition:** Utilizing the volume, lines, and colors of plants, artists create spatial compositions with painterly aesthetics. A three-tiered plant arrangement—foreground, midground, and background—serves as an effective approach: foreground elements like low-growing flowers or ground covers create accents, midground features medium-height shrubs or small trees as focal points, and background tall trees form a deep green backdrop. This layered structure with clear hierarchy enhances the landscape's artistic impact and visual coherence.

### **4.4. Humanistic and Health Functions**

Alleviate emotional distress and stress, and enhance residents' mental health status. Provide platforms for science education to disseminate botanical knowledge and ecological concepts. Preserve regional culture and nostalgic memories to strengthen a sense of belonging and identity.

Furthermore, creating safe and comfortable outdoor activity spaces encourages residents to engage in outdoor activities such as walking, resting, and social interactions, thereby promoting physical exercise and enhancing overall health. Simultaneously, substances released by plants, including negative oxygen ions, help improve surrounding air quality, providing residents with a fresh breathing environment that positively contributes to respiratory health. Certain medicinal plants can also be showcased in specialized science exhibitions to educate the public about their therapeutic properties, fostering greater awareness of health maintenance.

## **5. Main Forms and Artistic Techniques of Landscape Plant Configuration**

### **5.1. Common Configuration Forms**

**Solitary planting:** A single tree serves as the main feature, highlighting its form, posture, and scale. **Pairing planting:** Symmetrically planted at entrances and along building sides, serving to guide and enhance the landscape. **Cluster planting:** A combination of 3–10 trees forming natural groups with rich layers. **Group planting:** Large-scale planting creating forest belts, forest patches, or background forests. **Hedges and patterns:** Regular pruning used for boundaries, divisions,

and decorative styling. Vining plant configuration: Vertical greening covering walls, pergolas, and slopes. Aquatic plant configuration: Species such as lotus, water lilies, calla lilies, and calamus create wetland landscapes. Ground cover and flower borders: Cover the ground surface, enrich colors, and enhance landscape refinement.

## **5.2. Artistic Coordination Techniques**

Contrast and Harmony: High-low, color, form, and texture contrasts highlight focal points. Rhythm and Melody: Repetition, gradation, and alternation create a sense of order. Balance and Stability: Visual equilibrium on both sides and front-to-back positions prevents visual imbalance.

Subject and subordinate elements: The main scenic trees are prominent, with supporting plants arranged in a unified and harmonious manner. Integration of points, lines, and planes: Scenic trees, linear green belts, and planar forest canopies are combined.

## **6. Plant Configuration Strategies for Different Landscape Spaces**

Urban park plant design focuses on shading, recreational, ecological, and seasonal elements, utilizing large trees to create shaded spaces while incorporating flowering shrubs and ground covers. It features sparse woodland lawns, waterfront plant zones, specialized gardens, and children's play areas, balancing safety and aesthetic appeal. Residential area landscaping prioritizes safety, health, comfort, and low maintenance, avoiding toxic, thorny, or pollen-producing plants. Key arrangements include courtyard greening, pathway greenery, and a mix of evergreen and deciduous species to ensure year-round scenery and optimal ventilation. Roadside vegetation selection emphasizes pollution resistance, easy pruning, foot traffic tolerance, and high survival rates, employing tree shading, shrub barriers, and ground cover to form noise-reducing, dust-filtering, sight-guiding, and traffic-safe green corridors.

The plant configuration in waterfront green spaces primarily focuses on soil stabilization, bank protection, water source conservation, and water quality purification. It employs a combination of wetland-adapted, aquatic, and mesophytic plants to establish ecological banklines and near-natural wetland communities, thereby enhancing the self-purification capacity of water bodies.

The plant configuration in plazas and commercial spaces prioritizes regularity, neatness, grandeur, and trampling resistance, employing tree arrays, flower boxes, and hedges to soften hard surfaces and facilitate pedestrian flow management.

The roof and vertical greening configuration utilize lightweight, shallow-rooted, drought-resistant, and wind-tolerant plants to enhance thermal insulation, energy conservation, and carbon reduction effects. Ecological restoration and slope greening primarily employ native grasses and shrubs, pioneer tree species, and soil-stabilizing plants to achieve rapid vegetation coverage, prevent erosion, and facilitate gradual succession into stable communities.

## **7. Conclusion**

Plant configuration and planning constitute the essence and foundation of landscape architecture design, serving as a concentrated embodiment of ecological functions, artistic aesthetics, human health, and urban identity. In the new era, landscape plant design must transition from visual aesthetics to ecological prioritization, shift from short-term effects to long-term sustainability, adopt native species over exotic varieties, evolve from single-layer arrangements to multi-layered communities, and transform from extensive construction to meticulous management. This approach will ultimately achieve a harmonious integration of ecology, landscape, functionality, and cultural values.

Scientific plant configuration not only enhances urban greening quality, improves living environments, and strengthens urban resilience, but also provides crucial support for biodiversity conservation, carbon peaking and neutrality,

and ecological civilization development. In the future, as concepts like near-natural landscaping, healthy gardens, digital gardens, and low-carbon gardens gain deeper adoption, plant arrangements will become more scientific, localized, ecological, and human-centered. This will propel the landscape architecture industry toward higher-quality and sustainable development, offering robust green safeguards for building modern cities where humans and nature coexist harmoniously.

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## Disclosure statement

The author declares no conflict of interest.

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