Journal of Architectural Research and Development, 2025, Volume 9, Issue 4
https://ojs.bbwpublisher.com/index.php/JARD
Online ISSN: 2208-3537
Print ISSN: 2208-3529

Research on Construction Technology and Plant Beautification Strategies in Landscape Architecture Site Management

Zhihang Zhou*

Shenzhen University of Vocational Technology, Shenzhen 518000, Guangdong, China

**Author to whom correspondence should be addressed.*

Abstract: This paper explores the collaborative management model of construction technology and plant beautification strategies in landscape architecture site management. It analyzes the key aspects of construction technology and the implementation points of plant beautification strategies, constructs a synergy mechanism between technology and strategy, and proposes a dynamic adjustment and multi-professional collaboration model. The effectiveness of this model is verified through practical case studies, providing theoretical support and practical references for the refined construction of landscape architecture.

Keywords: Landscape architecture; Construction technology; Plant beautification

Online publication: August 6, 2025

1. Introduction

With the acceleration of urbanization, the importance of landscape site management has become increasingly prominent. Effective landscape management is of great significance for improving landscape quality, ecological benefits, and social functions. However, there are still shortcomings in the systematic integration of construction technology and seedling beautification strategies. The "Management Measures for the Application of National Garden Cities" promulgated in 2022 emphasizes the improvement of the level of urban garden greening construction and the promotion of high-quality development. In this context, this study aims to systematically integrate construction technology and plant beautification strategies. It proposes a collaborative management model that can enhance the efficiency and sustainability of urban greening projects. By integrating advanced building techniques with aesthetically pleasing plant arrangements, this model seeks to provide theoretical support and practical reference for the fine construction of landscape architecture. This integration is essential to meet the needs of urban ecological construction in the new era, ensuring that urban landscapes are not only functional but also visually appealing and environmentally sustainable.

2. Basic theory of landscape architecture construction technology

2.1. Concept and principles of landscape architecture construction technology

Landscape architecture construction technology is a systematic practice to achieve landscape design goals, covering the four-dimensional framework of system, technology, personnel, and environment. In terms of the system, it is essential to establish a comprehensive safety management system and detailed operational procedures to ensure construction compliance and adherence to regulatory standards. Technically, emphasis is placed on mechanization, informatization, and the application of ecological construction methods. For instance, BIM (Building Information Modeling) technology can be utilized to assist in construction planning, coordination, and execution, enhancing precision and efficiency. In terms of personnel, it is required that workers receive professional training to enhance their skills and safety awareness. Certification and pre-job briefings are crucial to reduce risks and ensure that each worker understands their responsibilities. In terms of the environment, it is necessary to dynamically evaluate the site conditions, monitor ecological changes, and avoid negative ecological impacts through sustainable practices [1]. Safety management focuses on accident prevention and risk minimization, following the principle of "prevention first, dynamic control." This involves constructing a full-process prevention and control network through risk prediction, hidden danger investigation, real-time monitoring, and the application of intelligent sensor technologies to achieve closed-loop risk management and ensure a safe and sustainable construction process.

2.2. Ecological, functional, and aesthetic theoretical foundations for the application of construction technology

The construction technology of landscape architecture relies on ecological, functionalist, and aesthetic theories. Ecology requires construction to protect biodiversity, create microhabitats to promote plant succession, and minimize environmental disruption. Functionalism emphasizes that the site space meets the needs of users, optimizes facility layout based on ergonomics, and ensures accessibility and usability for diverse populations. Aesthetic theory guides landscape shaping, using principles such as proportion, contrast, and harmony to enhance visual effects and create appealing landscapes [2]. The integration of these three theories ensures that the construction combines ecological sustainability, functional practicality, and aesthetic value. This holistic approach promotes the transformation of landscape architecture from mere "spatial construction" to "scene construction," where landscapes are not only functional and beautiful but also contribute to the overall quality of life and well-being of the community.

3. Key links in landscape architecture construction technology

3.1. Site preparation and earthwork engineering technology

3.1.1. Site cleaning and terrain shaping technology

Site cleaning is a crucial preparatory step before construction, involving the removal of construction waste, weeds, and obstacles. It also includes the classification and treatment of available resources, such as stripping surface fertile soil for later planting and recycling on-site materials to minimize waste. This process ensures construction safety and ecological sustainability by preparing a clean and stable base for subsequent work.

Terrain shaping is a key aspect of landscape construction, optimizing the landscape structure through earthwork excavation and micro-terrain design. Utilizing GIS elevation analysis and precise positioning from design drawings, the process involves mechanical and manual collaboration to control slope direction, gradient, and watershed [3]. The "contour line method" is often adopted to simulate natural terrain, reducing the need for external transportation through earthwork balance. Additionally, ecological slope protection techniques, such as grass planting grids and gabion retaining walls, are applied to enhance surface stability. These methods create a composite terrain system that blends seamlessly with the surrounding environment, ensuring both functional and aesthetic integration.

3.1.2. Soil improvement and drainage system design

Soil improvement and drainage system design are core components in ensuring the stability of plant habitats. Soil improvement needs to be targeted at the geographical characteristics of the site by adding humus, adjusting pH value, and constructing a permeable layer to enhance fertility and permeability [4]. The drainage system follows the principle of "stagnation, infiltration, and drainage" integration, and is equipped with blind ditches, infiltration wells, and rain gardens according to the terrain. For example, gravel blind ditches are set up in low-lying areas to accelerate infiltration. Balancing ecological and engineering needs in technical implementation, using permeable pavement and underground water storage tank linkage to achieve rainwater resource utilization; Collaborative design of improvement and drainage layer to avoid root rot caused by water accumulation. Scientific improvement and drainage optimization can increase the survival rate of seedlings by 15%–20%, reduce surface runoff pollution, and strengthen ecological resilience [5].

3.2. Construction technology of garden water and electricity and infrastructure

3.2.1. Intelligent configuration of the irrigation system

The intelligent configuration of irrigation systems aims to achieve precise water conservation and dynamically match plant water needs. A data-driven network is built through IoT sensors (such as soil moisture and weather stations) and cloud control platforms. The system real-time collects soil moisture content, evaporation rate, and plant transpiration rate, and combines AI algorithms to predict water demand. It automatically adjusts irrigation duration and frequency, such as reducing evaporation through nighttime drip irrigation during drought. Adopt zoning control, divide independent irrigation areas according to plant types and habitats, and configure pressure compensation drippers or nozzles. Communication technologies such as LoRa and NB IoT ensure low-power remote linkage of devices and real-time feedback of abnormal alarms to mobile terminals. Intelligent irrigation saves more than 30% of water compared to traditional methods, reduces labor costs, improves seedling survival rates, and achieves efficient use of water resources and sustainable landscape management.

3.2.2. Landscape lighting and concealed pipeline engineering

Landscape lighting and concealed pipeline engineering need to balance functionality and aesthetics. The lighting system follows the principle of low interference, using buried cables and waterproof joints to ensure safety, combined with LED energy-saving light sources to optimize light efficiency and avoid light pollution. The concealed engineering of pipelines ensures maintenance traceability through pre-embedded sleeves, identification positioning, and layered backfilling, such as burying water supply and drainage pipelines according to the depth and load requirements of frozen soil layers. In implementation, vegetation cover or artistic manhole covers are used to conceal pipeline nodes, achieving seamless integration of infrastructure and landscape, while balancing practicality and ecological aesthetic value.

4. Design and implementation of nursery beautification strategy

4.1. Design principles for seedling selection and configuration

4.1.1. The principle of adapting to the location and trees and ecological adaptability

The principle of adapting to the site and trees requires prioritizing the selection of seedlings that match the climate, soil, and hydrological conditions of the site, and building a stable plant community with local tree species as the core, such as using drought-tolerant tamarisk or seabuckthorn in arid areas. The principle of ecological adaptability emphasizes the synergy between plant stress resistance and ecological functions, selecting tree species based on physiological characteristics to avoid the introduction of invasive species that may trigger ecological invasion [6]. In practice, combined with the assessment of the ecological background of the site, a "climate soil plant" adaptation model is established, and a mixed forest configuration is adopted to enhance the community's anti-interference ability. For example, wetland plants such as reed and water fir are combined with the waterfront area to form a purification buffer zone. The planting density is controlled according to the ecological niche theory to reduce interspecies competition and ensure the long-term survival of seedlings and maximize ecological benefits.

4.1.2. Seasonal changes and aesthetic principles of spatial hierarchy

The principle of seasonal changes utilizes the seasonal differences in plant color and morphology, such as cherry blossoms in spring, ginkgo biloba in autumn, and red rosewood in winter, to create a "three seasons with flowers and four seasons with scenery". The aesthetic of spatial hierarchy emphasizes vertical matching, based on a three-layer structure of trees, shrubs, and ground cover, shaping visual depth through height, leaf shape, and color. Design incorporating principles such as proportion and rhythm, planting solitary trees to enhance focus, and repeatedly planting shrubs to form rhythm [7]. Functional space division is based on plant morphology, with dense bamboo forests as barriers and low grass flowers defining paths, achieving the unity of aesthetics and practicality, and promoting the sublimation of landscape from flat composition to three-dimensional scenes.

4.2. Nursery planting and maintenance management strategies

4.2.1. Seedling transplantation technology and measures to improve survival rate

The seedling transplantation technology needs to protect the root system and promote physiological recovery. Before transplantation, the diameter of the soil ball (usually 6–8 times the diameter at breast height) should be determined based on the characteristics of the tree species, and the fibrous roots should be retained. Redundant branches should be trimmed to balance the root-to-shoot ratio [8]. During planting, the method of "three burials, two steps, and one seedling lifting" is used, and loose soil is backfilled layer by layer and compacted to avoid air pockets. After transplantation, water balance is maintained through support fixation, shading and moisturizing, and drip irrigation micro-spraying. In off-season transplantation, rooting agents and anti-transpiration agents such as humic acid can be used to promote capillary root regeneration. The improvement of the survival rate relies on environmental control and fine operation, such as building windproof barriers, laying organic coverings to regulate surface temperature and humidity, monitoring soil EC values to avoid salinization, and ensuring a smooth transition of seedlings to normal growth.

4.2.2. Disease and pest control and long-term maintenance mechanisms

The prevention and control of pests and diseases is centered on "prevention first, comprehensive prevention and control", and reduces the number of pests and diseases through breeding disease-resistant varieties, ecological regulation, and crop rotation. The monitoring system combines IoT sensors and AI image recognition to analyze insect density and disease characteristics in real-time. Priority should be given to using biological methods for prevention and control, supplemented by precise application of low-toxicity chemical agents. Long-term management relies on periodic pruning, water and fertilizer regulation, and soil improvement. Establish digital archives for the maintenance process, record growth indicators and pest history, form a closed-loop mechanism, and ensure the scientific nature of prevention and control measures and the sustainability of the landscape.

5. Collaborative management of construction technology and nursery beautification

5.1. Construction of collaborative mechanism between technology and strategy

5.1.1. Connection between seedling protection and landscape during the construction phase

The protection of seedlings during the construction phase needs to be achieved through zoning operations and temporary protective measures, such as setting up fences to isolate the mechanical operation area, covering the root system with geotextile to prevent dehydration, and combining support fixation to avoid lodging. Landscape integration emphasizes the temporal matching of construction process and plant configuration, prioritizing the completion of terrain shaping and pipeline embedding to avoid rework and damage to seedlings in the later stage [9]. The connection design needs to reserve planting space and visual transition zones, such as using temporary green hedges or transitional paving to weaken construction traces, ensuring the continuity of the form and color of the new landscape and preserved vegetation. At the same time, the ecological continuity of the site can be maintained through the transplantation of seedlings in batches and immediate maintenance [10].

5.1.2. Dynamic adjustment and multi-disciplinary collaboration mode

Dynamic adjustment relies on BIM technology and on-site monitoring data to optimize construction plans and plant configuration strategies in real time, such as adjusting planting hole improvement measures based on soil testing results. Multidisciplinary collaboration requires integrating landscape design, civil engineering, and plant maintenance teams, establishing an information-sharing platform and collaborative decision-making mechanism, such as using 3D models to simulate spatial conflicts between pipeline routes and tree root systems, to avoid risks in advance. The collaboration mode emphasizes phased joint review and feedback iteration, where the construction, design, and maintenance parties jointly develop a list of seedling protection measures and emergency plans to ensure precise adaptation of technical parameters (such as irrigation pressure and lighting load) to plant growth requirements, achieving a dual improvement in engineering efficiency and ecological benefits.

5.2. Quality control and risk prevention

5.2.1. Key points of quality control during the construction phase

The quality control during the construction phase is centered around material acceptance and process standardization. Material acceptance verification includes verification of seedling quarantine certificates, building material testing reports, and environmental certifications for soil amendments. On-site sampling and retesting are conducted to ensure the absence of pests, diseases, mechanical damage, and chemical pollution. The process standards strictly follow national and industry norms, such as adding organic matter in proportion to soil improvement, pipeline welding meeting anti-corrosion grade requirements, and terrain shaping errors controlled within ± 5cm. Quality control runs through the entire construction process, achieving traceable management through concealed engineering acceptance, GPS positioning records, and BIM model comparison. For example, the compaction degree and slope of pavement engineering are checked layer by layer, and the integrity of soil balls and the effect of root water infiltration are verified after seedling planting to ensure accurate matching between technical parameters and design goals.

5.2.2. Risk prevention and control during the beautification stage of seedlings

Risk prevention and control during the beautification stage of seedlings focus on climate adaptability and long-term monitoring. Select stress-resistant tree species based on climate characteristics, such as choosing flood-tolerant fallen cypress in rainy areas and soil cover plants in arid areas. Measures for extreme weather include wind bracing, spraying antifreeze, and covering insulation film to reduce damage caused by cold wave or rainstorm. Post monitoring relies on IoT sensors and regular inspections to collect real-time data on soil moisture, EC values, and canopy growth status. It combines AI image analysis to identify disease spots or pests, such as using drones for multispectral scanning to evaluate survival rates. Prevention and control require the establishment of an early warning response system, the development of emergency plans for pests and diseases, soil salinization, and dynamic adjustment of irrigation and fertilization plans to ensure landscape ecological stability and visual sustainability.

5.3. Practical case analysis

5.3.1. Successful case: Collaborative experience in construction and plant configuration of an ecological park

A certain coastal ecological park project integrates processes through BIM technology to simulate and optimize spatial conflicts and layouts in advance. During construction, zoning operations are adopted, with priority given to completing micro terrain transformation and permeable paving, while preserving native trees and constructing a rainwater garden system. The plant configuration is mainly composed of salt-tolerant native tree species (such as *Ephedra* and *Paulownia*), combined with wetland plant communities to purify surface runoff. During the transplantation stage, soil ball moisturizing and drip irrigation systems are used to maintain water balance, ultimately achieving a seedling survival rate of 98%. The project relies on a multi-disciplinary collaboration platform to adjust the construction schedule and maintenance plan in real time, forming an integrated closed loop of “design construction maintenance”, effectively enhancing landscape integrity and ecological resilience.

5.3.2. Failure case: Analysis of seedling death and construction rework issues

During the construction of a certain urban park, the problem of seedling death and rework is prominent. Seedling death is due to severe damage to the root system during transplantation, such as soil balls being too small or scattered, causing dehydration of the root system. After planting, the seedlings were not supported and fixed in a timely manner, causing them to collapse in strong winds. Poor prevention and control of pests and diseases, inadequate monitoring, leading to the spread of pests and diseases. Construction rework is due to conflict between pipeline embedment and planting area, lighting pipeline too close to seedling roots. The terrain shaping slope is unreasonable, resulting in water accumulation. These issues reflect a lack of coordination between construction and seedling management, requiring optimization of processes and strengthened supervision to ensure the survival and construction quality of seedlings.

6. Conclusion

This study systematically explores the collaborative management of landscape construction technology and seedling beautification strategies, clarifying the key role of construction technology in ensuring the achievement of landscape design goals, as well as the important position of seedling beautification strategies in improving ecological benefits and landscape quality. By establishing a collaborative mechanism between technology and strategy, effective protection of seedlings during the construction phase and seamless integration with the landscape have been achieved. At the same time, relying on dynamic adjustment and multi-disciplinary collaboration models, the dual improvement of project quality and ecological benefits has been ensured. However, current research still has limitations, such as insufficient regional adaptability and lack of long-term effect data. Future research should focus on exploring intelligent construction technology, dynamic simulation of plant communities, and full lifecycle management models to further promote the refinement and scientific development of landscape management.

Disclosure statement

The author declares no conflict of interest.

References

[1] Xiangbo C, Shujun H, Shiya L, et al., 2023, Identifying Problems and Putting Solutions into Practice in Landscape Architecture Construction Management. Journal of Business Innovation, 8(1): 38.

[2] Fei S, 2024, Landscape Design Planning and Research of Renewable Energy Application Projects from a Sustainable Perspective. RE&PQJ, 2024: 138–151.

[3] Reyes AMT, Vega RC, Gutierrez CB, et al., 2023, Advances in Sustainable Landscaping: Innovation and Bioengineering Techniques for Environmental Conservation and Urban Sustainability. Aura, 2023: 313.

[4] Wang S, 2024, Landscape Architecture Planning and Design Based on Landscape Ecology Theory: A Case Study of Waterfront Landscape Planning and Design of Dapo Town. Journal of Landscape Research, 16(1): 35–42.

[5] Tian L, 2022, Analysis of the Artistic Effect of Garden Plant Landscaping in Urban Greening. Computational Intelligence and Neuroscience, 2022(1): 2430067.

[6] Luo L, Fang W, Wang X, et al., 2020, Application of Green Building in Landscape Planning of Characteristic Towns. IOP Conference Series: Materials Science and Engineering, 782(5): 052026.

[7] Yang L, Ye W, 2022, Landscape Design of Garden Plants Based on Green and Low-Carbon Energy Under the Background of Big Data. Energy Reports, 8: 13399–13408.

[8] Zhu L, 2022, Urban Landscaping Landscape Design and Maintenance Management Method Based on Multisource Big Data Fusion. Computational Intelligence and Neuroscience, 2022(1): 1353668.

[9] Deng Y, Xie L, Xing C, et al., 2022, Digital City Landscape Planning and Design Based on Spatial Information Technology. Neural Computing and Applications, 34(12): 9429–9440.

[10] Suna R, Zhub F, Yingc B, Research on Problems Existing in Urban Landscape Design and Its Countermeasures. Academic Journal of Environment & Earth Science, 5(5): 14–19.

Publisher's note

Bio-Byword Scientific Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.