Refined Management of Urban Landscaping Maintenance and Its Impact on Landscape Design

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Abstract: The confluence of rapid urban expansion and ecological pressures is shifting the focus of urban landscaping from "affordable to build" to "manageable to maintain well." Refined maintenance, centered on data support, process closed-loops, and result orientation, emphasizes the synergy between plant health, landscape quality, and urban character. It enhances green volume quality, ecological service functions, and public aesthetic experience, responding to resource constraints and high-quality development needs. Based on this, this paper explores the whole-life-cycle management of urban landscaping, delineates the connotation and characteristics of refined maintenance, and clarifies its role in improving the ecological environment, maintaining plant health, and enhancing urban cultural taste. It further analyzes its guiding effect on the rationality and aesthetics of landscape design. Specific pathways are proposed, including optimized vegetation allocation and zoned maintenance, professional and standardized management, integrated pest management, and optimization of irrigation and fertilization systems.

1. Introduction

In the current stage of modern urban development, the focus of landscaping is shifting from scale expansion to operational quality and ecological effectiveness. Under multiple pressures, extensive maintenance poses significant problems in seasonal performance, budget utilization, resource efficiency, and risk response, weakening the ecological services of green spaces and affecting the sustainable operation of landscape spaces and public perception. Based on this, this paper explores the connotation and key points of refined management, explaining its role in enhancing urban ecological quality, maintaining the health of landscape plants, and shaping urban cultural character. From the perspective of design-maintenance synergy, it demonstrates how refined management supports the rationality, aesthetic presentation, and durability of landscape schemes. Operable technical and managerial measures are proposed, aiming to provide reference for urban greening's transition from "building more" to "managing well and achieving practical results."

2. Definition and Characteristics of Refined Management

2.1 Definition

In the field of urban landscaping maintenance, refined management refers to the systematic, whole-life-cycle, and classified management of vegetation allocation, maintenance operations, facility upkeep, and risk prevention and control, based on the principles of clear objectives, quantifiable elements, controllable processes, and assessable results[1]. Its core lies in translating plant growth needs, site environmental characteristics, and usage loads into operable task lists and technical parameters, forming a standard→plan→execute→correct closed loop. It is based on small-scale unit grid management for precise supply of water, fertilizer, light, heat, and soil improvement. Using information ledgers and performance appraisal as tools, it achieves a balance between cost, quality, and safety. Through design→construction→maintenance linkage, it aligns landscape intent with maintenance capabilities, ensuring stable output and long-term sustainability of landscape quality.

2.2 Characteristics

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The characteristics of refined management are reflected in multi-dimensional coordination and whole-process control:

Firstly, the combination of unitization and gridization, subdividing green spaces according to function, site conditions, and pedestrian intensity, matching them with differentiated operation standards and resource allocation. Secondly, the simultaneous use of parametrization and listing, transforming water and fertilizer supply, pruning cycles, soil improvement, replanting, etc., into quantifiable technical indicators and planned work orders. Thirdly, closed-loop governance, driven by an inspection→record→correct→review chain for stable quality output. Fourthly, risk front-loading, establishing plans and threshold triggering mechanisms for extreme weather, high pest incidence periods, and facility aging. Fifthly, design→construction→maintenance synchronization, achieved through material selection, plant community structure, and maintainability assessment.

3. Significance of Refined Management in Urban Landscaping Maintenance

3.1 Improving Urban Ecological Environment Quality

Refined maintenance, through site-appropriate community allocation, precise irrigation, and scientific fertilization, steadily enhances the carbon sequestration, oxygen release, dust retention, noise reduction, and stormwater retention capabilities of green spaces, achieving sustainable provision of ecological services[2]. Using grid units as carriers, it implements differentiated management based on soil structure, micro-topography, and light patterns, improving root zone aeration and soil aggregate stability, and enhancing vegetation resilience to high temperatures, drought, and heavy rainfall. Rhythm control of pruning, renewal, and replanting manages canopy permeability and ground cover density, reducing evapotranspiration water loss and dust from bare soil. Utilizing reclaimed water and smart valve control reduces non-beneficial water use, complemented by organic and slow-release fertilizers to minimize nutrient loss and non-point source pollution. Early pest warning and threshold-based control maintain community diversity and ecological stability, thus effectively improving urban ecological environment quality under limited resource conditions.

3.2 Protecting Landscape Plant Health

Refined maintenance, based on simultaneous monitoring of plant vital signs and habitat elements, establishes a layered intervention system focusing on roots, canopy, and soil to reduce sub-health and premature decline. Traceable seedling sources, root control during planting, and optimized support reduce transplant stress. Pruning intensity and timing are set according to phenology and tree age to avoid concentrated wounds and nutrient imbalance. Localized deep loosening, microbial inoculants, and organic matter supplementation are applied to the soil to stabilize rhizosphere symbiosis and enhance stress tolerance thresholds. Water management employs dual-check strategies using evapotranspiration estimates and infiltration tests to prevent alternating waterlogging and drought. Pest management prioritizes threshold triggering and biological control, supplemented by trapping, wound sealing, and sanitary garden cleaning to reduce pest populations. Mechanical stability assessment and cavity repair are conducted for high-risk old trees and street trees, with preventive treatments based on electrical resistivity tomography and pull tests, improving plant health and longevity from the source[3].

3.3 Enhancing Urban Cultural Taste

Refined maintenance involves the expression of urban culture and the shaping of public aesthetics. Through rhythmic management of seasonal appearance, color, and texture, it ensures stable presentation of flower beds, lawns, and tree arrays at different times, forming street scene symbols memorable to citizens. Maintaining the stylistic order of historical trees and characteristic landscapes based on the spirit of the place avoids arbitrary replacement and stylistic discontinuity. Maintaining cleanliness and integrity of details like paving, street furniture, and lighting enhances the pedestrian experience and nightscape. Thematic floral events and temporary arrangements

during festivals and community activities increase participation and a sense of belonging. Accessibility, child-friendly, and elderly-friendly requirements are incorporated into maintenance details, making the landscape more inclusive and educational.

4. Impact of Refined Urban Landscaping Maintenance on Landscape Design

4.1 Promoting Design Rationality

Refined maintenance provides operable boundary conditions and feedback mechanisms for the design stage, ensuring schemes match the site, load, and maintenance capabilities from the outset. Through front-end assessment of soil bearing capacity, light chronology, wind corridor paths, and drainage capacity, plant community layers and density are calibrated, avoiding frequent post-construction replanting and overloaded maintenance. Pruning scales, equipment access widths, irrigation pipelines, and inspection points are incorporated into drawings, ensuring constructability, inspectability, and material replaceability. Listing constraints for seasonal performance, shade/drought tolerance gradients, and pest susceptibility reduces high-risk configurations. Introducing whole-life cost calculation and maintenance hour simulation optimizes the ratio of paving to ground cover, selects durable materials and low-maintenance varieties. Establishing a design→construction→maintenance joint review mechanism and sample section review forms a closed loop for iteration, thereby enhancing the logical integrity and operational rationality of the design[4].

4.2 Enhancing Design Aesthetics

Under the premise of balancing aesthetic appeal and usage scenarios, refined maintenance provides sustainable management of aesthetic elements, maintaining coherence and hierarchy in color, texture, and rhythm on an annual scale. Systematic scheduling of staggered flowering periods and leaf color gradients avoids short peaks and long gaps. Precise control of crown spread and branches shapes volume and silhouette, ensuring clear sightlines and visual foci. Detailed edging and gap management at the junction between ground cover and hard boundaries reduce clutter. Combined with lighting maintenance, climbing plant guidance, and cleanliness management of features, it enhances the nuanced expression of nightscapes and human-scale details. Daily maintenance of water clarity, fountain operation curves, and reflective surfaces strengthens light-shadow interaction and depth of field. This forms a positive cycle between design and maintenance, continuously improving aesthetics and place identity.

5. Specific Measures to Improve Refined Management of Urban Landscaping Maintenance

5.1 Optimize Vegetation Allocation and Implement Rationalized Maintenance

Optimizing vegetation allocation and rational maintenance focuses on "zoned configuration, targeted measures, and dynamic adjustment." Methods are as follows:

First, divide green spaces into small blocks based on soil, light, drainage, and pedestrian flow; select drought-tolerant species for dry areas, shade and waterlogging tolerant species for damp shady areas, forming multi-layered combinations of trees, shrubs, flowers, and ground cover for both beauty and manageability. Second, use trample-resistant grasses and low-maintenance shrubs in high-traffic areas, and use more native plants and seasonal flowering plants in quiet areas to reduce later replanting[5]. Third, establish simple, clear maintenance lists: indicate pruning times and intensity, thickness of organic mulch, when to replant and renew; set irrigation valves by zone, combined with soil moisture sensors or manual humidity checks, watering sufficiently without waste; conduct soil tests before fertilizing, prioritize slow-release and organic fertilizers, control nitrogen and phosphorus loss. Finally, improve green space boundaries and walking paths to reduce trampling; set up model areas and quarterly inspections, adjusting species or maintenance intensity where growth is poor, targeting resources to key areas for more stable overall results.

5.2 Strengthen Professional Technical Management and Improve Maintenance Standards

Strengthening professional technical management should advance simultaneously in team, system, and tools to steadily improve maintenance standards. Specific measures:

First, establish job grading and skill lists, clarify key points for operations like pruning, irrigation, fertilization, pest control, conduct onboarding training and annual assessments, and provide targeted training for deficiencies. Second, compile easy-to-understand operation manuals and on-site checklists, set special procedures and responsible persons for key nodes like seasonal pruning, flower bed renewal, and summer drought resistance. Third, improve the allocation of tools and equipment, regularly calibrate pruning saws, sprayers, soil samplers, pressure gauges, etc., keep common spare parts in equipment boxes to reduce downtime. Fourth, implement team meetings and on-site reviews, compile problem lists, form photo comparisons and rectification deadlines. Fifth, set up model sections and quality red/yellow lines, combine weekly inspections and monthly evaluations with rewards and penalties to ensure standard implementation. Sixth, strengthen liaison with design and construction units, update plant ledgers and facility drawings to avoid "blind maintenance" and " erroneous excavation". Through these measures, tasks become quantifiable, processes traceable, and problems closable, leading to more stable overall maintenance quality.

5.3 Implement Integrated Pest Management (IPM)

Integrated Pest Management emphasizes "prevention first, routine monitoring, precise control." Specific measures: Establish a list of common pests and diseases and a seasonal schedule, arrange inspection routes and frequencies by tree species and plot, focusing on new shoots, leaf undersides, branch forks, and root collars. Set yellow/blue sticky boards, traps, and pheromone lures, record pest counts regularly, and organize control only when preset thresholds are reached, avoiding blind pesticide use. Reduce conditions conducive to pests and diseases through ventilation pruning, cleaning up dead branches and litter, reasonable planting density, soil improvement, and moisture-retaining mulch. Prioritize physical and biological measures like high-pressure water washing, tree whitewashing, cavity filling, natural enemy release, and biopesticide application to reduce chemical input. If chemicals are necessary, implement targeted small-scale treatment, rotate pesticides with different modes of action, strictly observe safety intervals and personal protection, and fully record pesticide, dosage, time, and plot. Strengthen drainage and shading during rainy and high-temperature seasons to reduce root rot and mildew risks. Conduct monthly quadrat comparisons and brief reviews, adjusting thresholds and processes based on results, making control more stable, economical, and safe[6].

5.4 Optimize Irrigation and Fertilization Systems

Adopt the approach of "zoned water supply, demand-based fertilization" to build efficient and controllable water and fertilizer systems. Measures include: First, zone green spaces by soil, topography, and plant type; use sprinklers for lawns, drip or seepage irrigation for shrub and tree belts; install pressure gauges and air release valves at key nodes for easy inspection. Second, develop watering calendars, adjust duration and frequency based on recent 7-day rainfall and soil moisture readings, operate during early morning or evening low-evaporation periods to reduce surface water and runoff. Third, introduce reclaimed water or rainwater reuse, install filtration and desilting devices to prevent clogging of sprinklers and drippers. Fourth, implement seasonal irrigation, such as pre-winter watering, spring green-up watering, and summer drought resistance watering, combined with mulch to maintain soil moisture. Fifth, adhere to "soil test-based quantification, little and often" for fertilization, primarily using slow-release and organic fertilizers, supplemented by water-soluble fertilizers applied through irrigation during key growth stages. Sixth, set up impermeable barriers and isolation ditches in high-risk areas to prevent nutrient leakage. Seventh, maintain ledgers recording irrigation duration, flow rate, fertilizer usage, and plant response, review monthly and fine-tune parameters. Eighth, perform routine inspections of valve groups, pump stations, and pipelines, promptly replace wearing parts, ensuring stable system operation and resource conservation.

6. Conclusion

In summary, refined maintenance of urban landscaping should not remain a concept or slogan but must be implemented in zoned configuration, work orders, quality review, and performance improvement. With plant health as the bottom line, landscape stability as the goal, and resource conservation as the constraint, it promotes the synergy of design, construction, and maintenance. This paper, focusing on definition, significance, and impact on design, proposes a set of practices including vegetation optimization, professional management, integrated pest management, and water-fertilizer system optimization, with clear paths, defined responsibilities, and data traceability. Therefore, subsequent work requires verifying parameters in small areas first, gradually expanding to districts and entire regions, forming routine improvements through quarterly assessments and annual reviews. Through continuous iteration, green spaces can maintain stable performance across seasons and years, reducing high-frequency renovations and ineffective investment, thereby responding to public expectations with visible ecological quality, tidy landscape image, and friendly user experience, creating lasting value for urban spaces.

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