

Study on tree transplantation technology in urban landscape construction

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Abstract: With the rapid advancement of urbanization, urban landscaping plays a vital role in improving ecological quality. As a core component of greening projects, large tree transplantation demonstrates significant advantages in optimizing urban green space structures and enhancing landscape aesthetics. This paper systematically explains the concept and significance of large tree transplantation in urban landscaping, analyzes its technical characteristics and operational principles, and explores scientific methods for quality control and maintenance management across key stages including seedling selection, pit excavation, tree removal, and soil ball packaging. By implementing comprehensive precision management and standardized technical protocols throughout the transplantation process, transplant survival rates can be substantially improved, providing robust technical support for the sustainable development of urban ecological landscape systems.

1. Introduction

In today's China, where urbanization is accelerating rapidly, ecological environment and living quality have become crucial indicators of a city's sustainable development. Against this backdrop, landscaping serves as the primary medium to enhance both ecological functions and aesthetic value of cities, with its construction quality increasingly drawing public attention. Large tree transplantation stands as a pivotal technical aspect in landscape engineering, not only significantly elevating urban green spaces' visual appeal and ecological benefits in the short term but also playing an irreplaceable role in protecting rare species and optimizing vegetation structures. However, this process involves multiple complex elements including plant selection, soil adaptation, lifting and transportation, planting operations, and post-transplant maintenance. Improper procedures may easily lead to tree damage or reduced survival rates. Therefore, researching and promoting scientifically sound transplantation techniques while improving construction management processes holds significant practical importance for enhancing the overall quality and ecological functions of urban landscaping projects.

2 The concept and significance of tree transplantation in urban landscape construction

2.1 Concept

As a crucial technical measure in urban landscaping, large tree transplantation involves systematic standardization and procedural protocols for mature trees that have grown at their original locations before being relocated to new green spaces. This process enables the redistribution of urban greening resources and landscape reconstruction. While superficially appearing as simple tree "transplantation," it actually encompasses complex operations including plant physiological regulation, soil adaptation, mechanical lifting, and transportation placement. According to the "Code for Construction and Acceptance of Landscape Gardening Engineering" standards: deciduous trees with a trunk diameter exceeding 20cm or evergreen trees over 15cm are classified as large trees. These massive specimens, with extensive root systems, require meticulous care due to their inherent vulnerability to irreversible physiological damage from minor mishaps. Therefore, construction must prioritize structural integrity and stability, particularly through robust protection of trunks and canopies during excavation, transportation, and planting. This ensures proper adaptation and healthy growth of trees in new environments by preventing breakage,

imbalance, or water deficiency issues.

2.2 Significance

Large tree transplantation plays an irreplaceable role in enhancing the quality and ecological functions of urban landscapes. Compared to newly planted saplings, these mature trees offer greater volume, faster growth, and superior shade coverage. After transplantation, they quickly create high green coverage and visual focal points, significantly shortening landscaping construction cycles and improving green space utilization efficiency. Moreover, this method breaks away from traditional "zero-start" greening models by repurposing mature plants for optimized spatial layouts and enhanced ecological resilience. Particularly for rare ornamental species or historically significant ancient trees, transplantation serves as an effective approach for ex-situ conservation and propagation, preserving their ecological vitality while enabling sustainable development in new environments. In China's context of increasingly scarce urban land and shrinking ecological spaces, large tree transplantation not only addresses ecological gaps and strengthens green system functionality but also provides viable pathways for refined and efficient landscape management. This initiative carries profound implications for advancing urban ecological civilization and optimizing green spaces.

3 characteristics and application principles of tree transplantation technology

3.1 Main characteristics of tree transplantation technology

3.1.1 High difficulty of transplantation

Compared with regular saplings, transplanting large trees involves greater uncontrollable factors. As trees age, their root systems expand in both coverage and complexity, while their regenerative capacity significantly diminishes. During excavation and transportation, roots are prone to damage from shrinkage or rupture, while uneven stress on the trunk may cause fractures, resulting in higher maintenance costs. Moreover, transplanted large trees exhibit strong dependence on water and nutrient absorption, requiring meticulous management. Improper maintenance can easily lead to transplant failure.

3.1.2 The operation process is tedious

To ensure successful acclimatization of trees in new environments, extended preparatory measures are typically required prior to transplantation. These include cultivating new root systems and regulating growth patterns as part of preliminary preparations. The entire process comprises several stages: preparatory work, on-site operations, transportation and placement, followed by post-planting maintenance. Each phase demands meticulous management, requiring significant time and effort with no room for error.

3.1.3 Outstanding greening results

When large trees are successfully transplanted, they not only achieve an "instant landscape effect" within a short period but also significantly enhance the ecological quality and layered beauty of green spaces. Through simple pruning and maintenance, these trees quickly develop striking visual appeal, becoming focal points in urban greening that elevate the city's ecological image and aesthetic value.

3.2 Basic principles of tree transplantation technology

3.2.1 Tree balance principle

During transplantation, as root damage is inevitable, appropriate pruning of above-ground parts becomes necessary to achieve dynamic balance in tree vigor. This principle emphasizes the coordinated relationship between underground roots and above-ground branches in nutrient supply and growth. While excessive pruning may reduce root burden, improper regulation could weaken photosynthetic capacity and hinder recovery. Therefore, pruning intensity should be scientifically

determined by comprehensively considering species characteristics, root damage severity, physiological requirements, and landscape aesthetics.

3.2.2 Principle of analogous habitats

The success of tree transplantation primarily depends on whether the new environment closely resembles the original habitat. Key ecological factors like climate, soil composition, moisture levels, and sunlight exposure form the foundation for trees' adaptation. When transplanting to environments vastly different from their native conditions, trees' adaptability becomes significantly compromised. For example, planting alkaline-tolerant species in acidic soil often leads to transplant failure. Therefore, a systematic evaluation of the destination's soil and climate conditions should be conducted before transplantation. When necessary, soil improvement methods should be implemented to create an ecological environment similar to the original habitat, which effectively enhances survival rates and ensures stable growth.

4. Key points of tree transplantation technology in urban landscape construction

4.1 Seedling selection

Before transplanting large trees, comprehensive research should be conducted considering local topography, climate, sunlight conditions, and hydrological environment to scientifically select suitable tree species. When choosing species, both ecological adaptability to the local ecosystem and compatibility with tree age and variety characteristics must be considered. Taking greening projects in southwestern China as an example: evergreen species like osmanthus, crape myrtle, and red-leaf plum are commonly used; however, in southern Kunming, it's advisable to prioritize transplanting tropical or subtropical common mountain trees and magnolia plants based on local conditions.

4.2 Digging pits

Given the distinct climatic differences between northern and southern China, regions must comprehensively consider seasonal rainfall patterns and soil moisture levels when determining optimal transplanting schedules. In particularly humid southern areas, thorough assessments of soil structure and drainage capacity are essential before excavation to prevent root rot caused by waterlogging. The pit dimensions should be calculated based on the tree's girth, typically measuring 8-10 times the trunk diameter in diameter and extending 80% below the root ball height. During excavation, surface compacted soil and subsoil should be separated for separate placement. All debris and hard objects within the pit must be thoroughly cleared to create a stable foundation for subsequent planting.

4.3 Tree digging

When excavating large trees, use the tree's diameter at breast height (DBH) as a reference to determine the excavation radius, which should be 3-5 times the DBH. Typically, this involves drawing a circular area around the trunk center and digging in concentric layers to avoid damaging the root system. During operation, gradually expand the working area to maintain a 60-80 cm clearance zone. When the root ball approaches its bottom 20 cm mark, slow down the digging speed and adjust its shape to create a smoother base, ensuring optimal stability for subsequent transportation and positioning.

4.4 Earth packing

After shaping the root ball, immediate stabilization and binding should be performed. First, wrap grass ropes around the base 15-20 cm from the top to form a horizontal "belt" with a width of approximately 15-20 cm, which enhances stability. Next, use the "pepper-eye" method – wrapping ropes around the root ball from multiple angles and securing them at staggered points. This technique prevents cracking during lifting and transportation. This procedure not only strengthens the root ball's overall integrity but also ensures reliable handling throughout the transplanting

process, effectively avoiding structural damage during transport.

5. Quality control method of tree transplantation technology in urban landscape construction

5.1 Scientific treatment of trees

Before initiating large tree transplantation, a comprehensive assessment of the tree's condition must be conducted, with management strategies formulated based on its physiological characteristics. For evergreen trees, maintaining natural crown morphology during preparation is crucial. Where feasible, professional staff should remove dead branches and fallen leaves to reduce transpiration. When such trees retain intact root balls, pruning procedures can be appropriately simplified. Deciduous trees require structural pruning prior to transplantation, typically removing 1/3 to 1/2 of their foliage to minimize water demand. Transplanting in extreme weather conditions (e.g., high temperatures or severe cold) necessitates climate-adaptive adjustments to enhance survival stability.

5.2 Contracted work during the transplanting phase

After completing tree preparation, immediate trunk and main branch wrapping becomes essential for transportation safety. This critical step typically involves wrapping branches with natural materials like straw ropes or burlap sacks to provide cushioning and protection. The process should be conducted in shaded areas to prevent sunlight from accelerating moisture evaporation, which could compromise the tree's water retention capacity and stress resistance. Workers must continuously monitor the wrapped sections' moisture levels and apply misting techniques when necessary. This scientific wrapping method not only prevents physical damage during transit but also effectively mitigates risks from violent impacts and friction, ensuring both safety and stability throughout the transplanting operation.

5.3 Lifting and transportation

The tree lifting and transportation process presents the most stringent technical requirements throughout the transplantation workflow. When lifting, machinery such as cranes or forklifts should be selected based on the tree's size, shape, and center of gravity. During transportation preparation, the root ball's central position must be precisely positioned to prevent compression or impact on the roots during transit. From a structural perspective, the crown should be oriented toward the rear with secure ropes for full anchoring. To avoid soil loosening or fragmentation caused by road bumps, cushioning materials should be packed into the root ball to enhance stability and shock absorption capabilities.

5.4 Planting tips

The tree planting process, as a critical step in the entire transplantation procedure, must strictly adhere to technical standards. First, before planting begins, the tree pit layout should be properly designed, with dimensions and shapes carefully considered based on the tree's volume and root distribution to ensure sufficient growth space. If the soil in the area is poor—such as being heavy clay or poorly aerated—pit specifications should be appropriately increased, particularly ensuring vertical excavation accuracy to eliminate issues like sloping walls or water accumulation. When the digging depth meets the standard, it's recommended to pre-set a 30 cm loose soil buffer layer at the pit bottom to enhance its permeability and drainage characteristics. Additionally, topsoil and new soil should be separately piled and identified for layered treatment during backfilling to improve soil structure. If roots or branches are damaged during transplantation, they must be immediately cleared and trimmed with smooth cuts. The cut ends should be coated with preservatives or wrapped in plastic film to prevent pest infestations that could affect future recovery.

5.5 Subsequent maintenance and management

5.5.1 Water management

After transplantation, the tree has strong transpiration and is easy to lose water. Therefore, under the premise of reasonable arrangement of watering frequency and coverage, measures should be taken to wrap the tree trunk to reduce water evaporation. It is necessary to avoid providing water only to one corner of the root, and ensure that the surrounding soil is moist and balanced to create a good water environment.

5.5.2 Stimulating root growth

Under new environmental conditions, trees experience reduced absorption capacity, necessitating the use of plant growth promoters like rooting powder to activate root regeneration. Additionally, appropriate irrigation is essential for efficient nutrient uptake, enhanced root vitality, and accelerated adaptation of the tree.

5.5.3 Weeding and soil loosening

After completing tree planting, maintaining a clean and well-ventilated environment is crucial. Regular weeding and soil loosening help prevent weeds from competing for water and nutrients, as well as vines from shading photosynthesis. Additionally, avoid human trampling or vehicle damage to the tree's base area. Keeping soil loose promotes air circulation and water absorption, ensuring healthy root development and supporting the tree's continued growth.

6. Concluding remarks

In the era of rapid urbanization, landscape engineering has become increasingly vital for building livable eco-cities, serving as a cornerstone for promoting green development and ecological civilization. Large tree transplantation stands as a pivotal step in urban greening, crucial not only for scientifically structured vegetation but also for maintaining stable and aesthetically pleasing urban ecosystems. This process effectively enhances the ecological quality of urban green spaces, optimizes vegetation distribution, and elevates visual appeal. To ensure successful transplantation, it is essential to implement meticulous management throughout the entire process and conduct systematic research. Continuous refinement of technical approaches will guarantee transplant success rates, thereby establishing a solid foundation for improving urban landscape ecology and enhancing green space quality. These efforts ultimately inject new momentum into the sustainable development of China's landscape architecture sector.

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