

# Analysis of Residential Area Plant Configuration

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## Abstract

**With the acceleration of urbanization in China, people's awareness of ecological protection has been continuously increasing. In urban construction, the greening of residential areas has become a focal point. This article aims to elucidate the principles and methods of plant configuration and selection in residential area greening. From the perspectives of plant physiology, ecological indicators, and landscape aesthetics, principles and methods for rational plant configuration in different environments are proposed. Whether plants are used as main features or incorporated with other landscaping elements to form main features, attention needs to be paid to configuration methods, artistic techniques, and the selection and quantity of plant species. Furthermore, following the requirements of plant landscape design, issues to be considered in the process of plant configuration are discussed, along with their contribution to the residential area development.**

## Keywords

**Residential area; Greening; Plant configuration.**

## 1. INTRODUCTION

If landscape greening is known as the "lungs of the city," then residential greening is the "natural haven of residents' homes." Residential areas should become garden-style living environments that allow urban dwellers to reconnect with nature, offering a pleasant atmosphere filled with the beauty of coexistence between humans and nature. In landscape design, the successful application of plants lies in their ability to harmonize their non-visual functions with visual aesthetics. We understand that the proper selection and arrangement of plants can create personalized and beautiful landscapes, attracting residents to rest, engage in recreational activities, participate in events, learn, and communicate.

Plant configuration is not only about creating visual and artistic landscapes; it also encompasses ecological and cultural landscapes and even carries deeper significance. The concept of plant configuration has evolved from the traditional emphasis on visual effects to become an integral part that emphasizes the combined visual and ecological effects. In this article, the author conducted a comprehensive investigation and discussion on the plant configuration in residential areas, aiming to provide assistance and inspiration to readers seeking relevant information.

## 2. PRINCIPLES OF PLANT UTILIZATION

In plant landscape design, it is important to combine large-scale area plants with unique spot plants to enrich the space. Avoid excessive dispersion of plants, as it can lead to a messy and disorganized space lacking overall coherence. When planting large-scale area plants, attention should be paid to the spacing between plants to allow room for growth. For tall and aesthetically

pleasing tree species, single planting can be employed to fully showcase their aesthetic value and add color to the design. In three-dimensional planting, combining multiple plant species on the vertical plane can create a rhythmic effect. Different textures and colors can be utilized to achieve a harmonious and contrasting visual impact. Creating spaces for relaxation and utilization beneath taller plants, such as installing seating or pathways, can increase the utilization rate of vegetation while ensuring harmony between plant placement and ground design. When there is a lack of unity among buildings in mountainous areas, plants can be used to accentuate certain spaces, such as courtyards or building entrances. Additionally, plants can serve as backgrounds to highlight focal points. In cases where the composition formed by the topography and buildings is not yet perfect, plants can be utilized to refine and improve it. It is advisable to choose local plant species for their application, as it can reduce costs, improve survival rates, and contribute to the formation of local characteristics.

### **2.1. Principle of Harmony: The Principle of Coordination and Contrast**

In plant landscape design, it is important to consider the interconnection and coordination among plants to create a soft, calm, comfortable, and pleasant aesthetic. By selecting plants with similarities and consistency for planting, a harmonious effect can be achieved. Conversely, through the use of differences and variations, a contrasting effect can be created, bringing a strong sense of stimulation and generating excitement, warmth, and exuberance in the visual experience. Therefore, in plant landscape design, contrasting techniques are often employed to highlight themes or capture attention. Additionally, when integrating plants with architectural elements, attention should be paid to the proportional coordination of volume, weight, and other factors. This ensures visual balance and harmony between plants and structures.

### **2.2. The principle of balance: This is a layout method used in a plant arrangement**

By arranging plant species with different volumes and textures according to the principle of balance, the landscape can appear stable and more pleasant. Some considerations include the depth of colors, the size of volumes, the moderate quantity, the delicate texture, and the density of foliage. Plant species with dense, large, numerous, thick, and lush characteristics give a sense of heaviness, while plant species that are light, small, moderate, delicate, and sparse give a sense of lightness. When arranging, it is also important to choose between regular balance (symmetrical balance) or natural balance (asymmetrical balance) based on the surrounding environment. Regular balance is often suitable for places with regular architecture, such as solemn mausoleums or grand royal gardens, while the natural balance is commonly used in gardens, parks, botanical gardens, and scenic areas with a natural environment.

### **2.3. Principle of Rhythm and Harmony: Regular variations in planting create a sense of rhythm.**

Taking into consideration economic functionality, the greening of residential areas focuses on trees and flowers, aiming to increase green coverage and achieve positive ecological and environmental benefits. To achieve year-round landscapes and early implementation of widespread greening, different types of trees can be planted. This includes evergreen and deciduous trees, tall trees and shrubs, fast-growing trees and slow-growing trees, as well as a combination of key tree species and general tree species to create diverse tree forms and color variations. Additionally, planting hedges, flowers, and lawns enhances the interplay between trees, shrubs, flowers, hedges, and lawns, enriching and beautifying the residential environment. The specific details are as follows:

#### **2.3.1 Plants suitable for upper-level planting**

1). Deciduous Trees: *Ginkgo biloba* L.; *Koelreuteria paniculata* Laxm.; *Acer truncatum* Bunge; *Platanus × acerifolia* (Aiton).

2). Evergreen Trees: *Cedrus deodara* (Roxb.) G. Don; *Juniperus chinensis* 'Pyramidalis'; *Platycladus orientalis* (L.) Franco; *Pinus tabuliformis* Carrière.

#### 2.3.2 Plants suitable for middle-level planting

1). Plants suitable for shade conditions under the forest canopy: *Forsythia suspensa* (Thunb.) Vahl; *Cornus alba* L.; *Lonicera maackii* (Rupr.) Maxim.; *Kerria japonica* (L.) DC.

2). Plants suitable for partial shade or full sunlight conditions under the forest canopy are *Cercis chinensis* Bunge, *Sorbaria sorbifolia* (L.) A. Braun, *Berberis thunbergii* var. *atropurpurea* Chenault, and *Juniperus procumbens* Sargent.

3). Plants suitable for planting along the forest edge or in open areas with sparse vegetation: *Cotinus coggygria* Scop., *Malus × micromalus* Makino, *Prunus cerasifera* f. *atropurpurea*, *Lagerstroemia indica* L., and *Jasminum nudiflorum* Lindl.

#### 2.3.3 Plants suitable for undergrowth planting

*Viola yedoensis* Makino, *Lonicera japonica* Thunb., *Euonymus fortunei* (Turcz.) Hand. -Mazz., *Trifolium repens* L., *Juniperus procumbens* Sargent.

#### Plant communities that showcase the landscape in spring

Upper trees: *Salix babylonica* L., *Liriodendron chinense* (Hemsl.) Sarg., or *Ailanthus altissima* (Mill.) Swingle

Middle trees: *Ligustrum lucidum* Ait., *Syringa oblata* Lindl. or *Prunus cerasifera* f. *atropurpurea*

Lower trees: *Prunus triloba* Lindl., *Jasminum nudiflorum* Lindl., *Rosa multiflora* Thunb., *Weigela florida* (Bunge) A. DC.

Ground covers: *Iris tectorum* Maxim., *Orychophragmus violaceus* (L.) O. E. Schulz, or *Parthenocissus quinquefolia* (L.) Planch.

#### Plant communities that showcase the landscape in summer

Upper trees: *Koelreuteria paniculata* Laxm.

Middle trees: *Ligustrum quihoui* Carr., *Hibiscus syriacus* L. or *Sorbaria sorbifolia* (L.) A. Braun

Lower trees: *Rosa chinensis* Jacq. or *Canna indica* L.

Ground covers: *Lycoris radiata* (L'Her.) Herb. or *Scutellaria barbata* D. Don

#### Plant communities that showcase the landscape in autumn

Upper trees: *Crataegus pinnatifida* Bunge, *Deutzia crenata* Siebold & Zucc.

Lower trees: *Rosa chinensis* Jacq., *Berberis thunbergii* var. *atropurpurea* Chenault or *Juniperus procumbens* Sargent

#### Plant communities that showcase the landscape in winter

Upper trees: *Cedrus deodara* (Roxb.) G. Don, and *Celtis sinensis* Pers.

Middle trees: *Chimonanthus praecox* (L.) Link

Lower trees: *Ilex cornuta* Lindl. & Paxton

Ground covers: *Juniperus procumbens* Sargent, and *Ophiopogon japonicus*, Ker.

## 2.4. Diversified greening and plant configuration in residential areas

In residential area greening, the planting forms of trees and flowers should be diversified. In addition to planting trees with broad crowns and good shading effects along the roadsides, methods such as cluster planting and group planting can be employed to break the monotony and dullness of residential areas. By using various arrangements of plants, the spatial variation can be enriched and combined with the orientation of roads, buildings, doorways, and other elements to create landscape effects such as focal points, framing, and visual interest, thereby

creating a pleasant landscape environment. When selecting plant materials, excessive variety should be avoided while avoiding monotony. The aim is to achieve a unique character through the selection of plant materials, allowing for a diverse overall greening presentation. Residential area greening is a collective endeavor, and it is advisable to choose robust, easy-to-manage, disease- and pest-resistant tree species that possess local characteristics. Additionally, multiple climbing plants should be planted on green building facades, fences, and low walls to enhance the three-dimensional greening effect of residential areas and utilize climbing plants to conceal unsightly objects.

### **3. HANDLING THE SPATIAL AND TEMPORAL ARRANGEMENT OF PLANT CONFIGURATION**

In residential area greening, ecological landscaping theory should be applied as the basis, simulating natural ecological environments and utilizing plant physiology, ecological indicators, and principles of landscape aesthetics for plant configuration. This aims to create a multilayered structure, ensuring the stability and longevity of plant communities in both spatial and temporal dimensions.

#### **3.1. Spatial arrangement**

In addition to the central green area, the majority of green spaces in residential areas are distributed in front and behind the houses, often arranged in rows, creating parallel and equally-sized green spaces that give a sense of elongated space. Therefore, it is possible to make full use of combinations of different plants to break up the existing rigid spatial layout and create a lively and harmonious environment.

#### **3.2. Linear Variation**

Due to the presence of parallel straight lines in the residential area's green spaces, such as roads, fences, and residential buildings, various techniques can be employed in plant arrangement to incorporate the curvilinear variations of plant edge lines and the undulating variations of tree canopy lines. Techniques that emphasize the changes in plant edge curves include: on the shrub edges, dense planting can be implemented by utilizing compact and foliage-rich flowering shrubs, creating meandering curves with intricate variations. Incorporate isolated plantings of spherical-shaped plants by placing several isolated plantings at the edges of the green space, enhancing the meandering variations of the edge line. To highlight the undulating changes in the canopy line, techniques include using plants with spire-like forms to create more pronounced variations and a sense of rhythm in the canopy line. Utilize changes in terrain to achieve corresponding undulations in the canopy line, even among plants of similar heights. This type of change is more subtle and has a slower rhythm. Additionally, utilize plants of different heights and diverse canopy structures to create moderate undulations in the canopy line.

#### **3.3. Seasonal variation**

The residential area is an environment where residents live and relax throughout the year. Plant configuration should take into account the seasonal changes of the four seasons, synchronizing with the residents' life rhythms in spring, summer, autumn, and winter. To achieve this, the following aspects can be considered: In a residential area, emphasis is placed on the seasonal changes to present a vibrant display of blooming flowers in spring, refreshing greenery and fragrance in summer, fiery foliage in autumn, and evergreen landscapes in winter. For example, in a panoramic four-season garden, the use of gently undulating terrain on both sides and plants that bloom in different seasons creates a central axis with framed views, showcasing the diverse plant landscapes of each season. This approach not only meets the

requirements of the landscape design, where each season has its own unique features, but also establishes a strong connection with the themes of the four seasons. In a specific area or around a particular building, it is possible to highlight specific plant characteristics, such as focusing on *Prunus subg. Cerasus* sp. species in a cherry blossom garden and accentuating the scenery of a particular season, such as spring, summer, autumn, or winter.

#### 4. CONSIDERATION OF HUMAN PSYCHOLOGICAL NEEDS

Creating a plant landscape environment that is pleasing to the mind and body by utilizing the five senses of people is a crucial factor to consider. In the design process, we should incorporate a human-centered experience and strive to create a plant landscape that excels in the five senses of "sight, sound, smell, taste, and touch."

##### 4.1. Visual effects

The color of plants can adjust people's emotions and alleviate stress at work and in daily life. However, it is important to use warm, neutral, and cool-colored plants in a balanced manner. Warm-colored plants can create a sense of warmth, while cool-colored plants can help maintain a calm state of mind. For example, warm-colored plants such as *Lagerstroemia indica* L. and *Acer palmatum 'Atropurpureum'* (Van Houtte) Schwerin can create a comfortable and enthusiastic communication atmosphere. In relaxation areas, evergreen trees and shrubs can be selected to create a tranquil ambiance. When choosing plant species, it is recommended to prioritize diversity, considering the crown shape, color, seasonal characteristics, and planting form of the plants to create a visually rich effect.

##### 4.2. Auditory effects

In auditory landscapes, examples like the gentle rain in a bamboo forest, the breeze rustling through a courtyard, or the sound of rain falling on banana leaves are all classic illustrations that create pleasant auditory experiences through the generation of natural sounds. Different sounds evoke different sensations in people through their auditory perception. In residential areas, it is important to consider noise isolation and utilize natural sounds to create a favorable auditory landscape. One effective design approach is to incorporate a combination of tall trees and shrubs, creating a multi-layered plant community that enhances the three-dimensional effect and achieves optimal sound insulation. Here are some plants suitable for noise reduction, including *Ginkgo biloba* L., *Cedrus deodara* (Roxb.) G. Don, *Platanus × acerifolia* (Aiton), *Ligustrum lucidum* Ait., and *Osmanthus* sp.

##### 4.3. Olfactory effects

Some plants can kill bacteria and purify the air. For example, plants from the *Pinaceae* Spreng. ex F. Rudolphi, *Cupressaceae* Gray, and *Magnoliaceae* Juss. families have excellent inhibitory effects on pathogens such as *Mycobacterium tuberculosis*. Plants such as *Cycas revoluta* Thunb., *Punica granatum* L., and *Camellia japonica* L. are capable of effectively removing harmful gases such as sulfur dioxide, chlorine, ether, ethylene, carbon monoxide, and hydrogen peroxide from the air, thereby achieving a good air purification effect. In northern gardens, common tree species such as *Pinus bungeana* Zucc. ex Endl., *Juniperus chinensis* Roxb., and *Prunus persica* 'Duplex' have strong antifungal capabilities, making them suitable for increased planting. In southern gardens, *Ginkgo biloba* L., *Ailanthus altissima* (Mill.) Swingle, and *Platanus × acerifolia* (Aiton) Willd. release a significant amount of antibacterial substances, making them suitable for extensive use.

#### 4.4. Fragrance Effect

Some plants produce and release various fragrances or volatile substances through their stems, branches, leaves, and other parts. These substances can enter the human respiratory system or be absorbed through the pores, playing a role in disease prevention, strengthening the body, and promoting longevity. For example, *Syringa oblata* Lindl. and *Gardenia jasminoides* Ellis can help relax the body and mind. *Cinnamomum camphora* (L.) J. Presl releases acetone, the main component of cooling oil, which can help invigorate and awaken the mind. *Ginkgo biloba* L., *Yulania denudata* (Desrousseaux) D. L. Fu, and *Acer palmatum* Thunb. in Murray contain salicylic acid compounds, which have a role in daily cardiovascular health maintenance.

#### 4.5. Tactile Sensation

In the perception of sound, color, scent, taste, and touch, the sense of touch is the most elusive as it requires physical contact to be experienced, thereby stimulating physiological responses and conveying emotions. For plants, the texture of their leaves and bark can provoke contemplation and evoke emotions in people. However, it is important to note that sharp or thorny plants should be avoided along road edges to prevent injury to those touching the plants.

Accessible road design reflects human-centeredness, with railings designed to facilitate use by visually impaired individuals, ensuring safety. Proper allocation of green space and space size are crucial. Excessively large green areas may reduce practicality and diminish residents' sense of belonging. Therefore, people prefer green landscapes closer to the front of residential areas. In green design, the focus should be on creating pleasant and welcoming green spaces centered around clusters. Integrating greenery with pathways and trails allows people to both stroll and find convenient spots to rest, fully enjoying the pleasures of nature. It is advisable to avoid enclosed and cramped spaces to prevent a sense of insecurity among individuals.

## 5. PLANT CONFIGURATION IN VARIOUS FUNCTIONAL AREAS OF RESIDENTIAL COMPLEXES

### 5.1. Roadside greenery in residential complexes

Practicality, warmth, coziness, and pleasure are the starting points for road landscape design. Along the sides of residential complex roads, fast-growing broadleaf trees are used as guiding plants, followed by dominant evergreen trees. In spacious areas, there can be concentrated planting of tall trees, shrubs, and plant color bands to achieve vertical and horizontal contrasts in landscape colors while adhering to the principles of variation and unity in planting. Local greenery blends with the greenery in front and back of buildings, incorporating focal points and lines to create integrated spaces for relaxation, scenery, and viewing, thus achieving a seamless integration of road and building greenery. When selecting broadleaf trees, the focus is on the principle of diverse ecological communities, aiming to create a favorable ecological environment by arranging a variety of plant communities.

### 5.2. Central Park greening in residential areas

The planning and design of the central park in the residential area should pursue harmony with nature and be rich in natural appeal. Rationality refers to the utilization of natural terrain, the arrangement of scenic spots, and the layout of plants to achieve a perfect combination of nature and functionality. Appeal refers to the incorporation of natural wildness and tranquility in the environmental layout techniques, reducing artificially deliberate designs to make them more natural while retaining an artistic touch. In environmental landscape design, conditions close to nature should be created for people, such as opening up lawns in enclosed green spaces and allowing residents to enter and take walks, lie down, or play on the grass.

### 5.3. Cluster greening

In the larger corner areas within the residential complex, seasonal landscape configurations can be implemented throughout spring, summer, autumn, and winter. By combining the variations in terrain and densely planting flowers to form a colorful strip, the surrounding plant landscape of the buildings achieves both diverse spatial changes and contrasts as well as seasonal variations over time. This creates a sense of "forest within the city, city within the forest."

### 5.4. Greening at intersections and corners

At the intersections and corners leading to each building in the residential area, stone features are placed to give them distinctive and iconic characteristics. They are accompanied by abstract, smooth, and vibrant low-growing flowering shrubs to create a striking visual effect. Under the sparse forest canopy, stone landscapes and benches are arranged, along with paved small squares. These spaces can be used for morning exercises, afternoon relaxation, and evening neighborhood interactions, fully reflecting the design concept of being people-oriented and user-friendly. Varying micro-topography designs are employed between buildings, with elevation changes not exceeding 1 meter but maintaining a smooth and natural form, covered with lush green grass. This creates a sense of living in the embrace of nature for residents, embodying the creative concept of "returning to nature."

### 5.5. Greening of the residential parking area

In the residential parking area, it is recommended to use permeable and breathable grass pavers instead of fully sealed concrete surfaces. This allows for the planting of lawns while still providing parking functionality, creating a harmonious integration with the surrounding trees and shrubs. The interplay between the lawn and the trees can create a strong ecological complementarity and balance, increasing the green coverage and enhancing the aesthetic appeal of the landscape. This approach can also be applied to slopes and embankments, where grass pavers can serve as erosion control measures while blending seamlessly with lawns and trees.

### 5.6. Greening of the green spaces adjacent to residential buildings

The greening of green spaces adjacent to residential buildings is an important place for residents' daily leisure and social activities, and it serves as the foundation of the community's overall greening. Moreover, these green spaces play a role in beautifying, decorating, and identifying residential buildings. Therefore, a well-designed green space adjacent to residential buildings can harmonize the plants with the architectural landscape. As part of the community's green space system, these green spaces constitute the "area" component in the point-line-area system. They not only impact the lives of residents but also influence the overall effectiveness of the green space system. Due to their proximity to residents, these green spaces can be self-managed by the residents themselves. Since their area is typically small, the focus is primarily on greening. It is important to consider the needs of the elderly and children as the main target users and incorporate the psychological and physiological characteristics of these groups in the plant selection while also creating various activity spaces. Seasonal variations should be considered in landscape composition, and ensuring adequate lighting and air circulation is essential. A proper mix of trees, shrubs, and lawns should be arranged. The use of climbing plants for vertical greening, especially in smaller spaces, can be beneficial. For windows facing the south of the buildings, it is suitable to plant low shrubs and deciduous medium-sized trees with dense foliage to meet the ventilation requirements of low-rise buildings. In conclusion, a well-designed and configured green space adjacent to residential buildings can provide

residents with a pleasant leisure environment, meet the needs of the elderly and children, and enhance the overall greening level of the entire community.

## 6. CONCLUSION

Landscape design concepts and methods of plant configuration in residential areas are gradually maturing. Although there are still some shortcomings in the current greening and plant configuration, with a deeper understanding of plant habits and further research in landscape aesthetics, landscape ecology, and landscape behavior, the greening of residential areas will gradually develop towards humanization, scientificity, and practicality. In today's society, people yearn to reconnect with nature amidst the concrete jungle and busy urban life. Therefore, in residential areas, plant landscaping should follow natural laws and make moderate adjustments while minimizing human interference, to achieve a harmonious blend of artistic expression and the needs of modern individuals, showcasing the unique artistic effects of plants in gardens.

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