Study on planting structure in multiple levels

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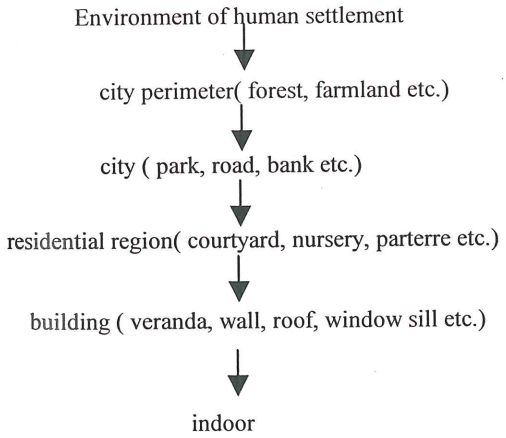
Abstract: Presents the meaning and purpose of planting in multiple levels. Puts forward the concept of ecological environmental benefits of planting. Discusses in detail the optimum system of the planting structure in multiple levels, which includes foundation, methods, quantification and planning ways. Declares planning process of the optimum system of planting structure in multiple levels for residential field.

Keywords: Planting in multiple levels, ecological environmental benefits of planting, optimum system of the planting structure.

1. Introduction

1.1 Definition

Planting in multiple levels is an combination of many planting types, which include indoor planting, building planting(the roof, wall, veranda planting etc), road planting, bank planting, residential region planting and forest planting of city circulation. Its system diagram can generalize as follows:



1.2 Purpose of research on planting structure in multiple levels.

Planting structure in multiple levels is a gathering of several of green land, which have output of social benefits, economic benefits and environment benefits. The function of planting includes not only ecological effects, which is about modulating microclimate, equilibrating carbon dioxide and oxygen, purifying the air, reducing the noisy, defending wind and keeping sand, but also social effects caused by ecological effects, which can bring human a comfortable and pleased feeling physically or mentally, also improve humanities environments. Therefore, we can put forward the concept of ecological environment effect. It can be described completely as follows:

Generation of ecological environment function

Planting→ecological benefit→adjusting people physically and mentally improving humanities environment→social benefits

Planting in multiple levels is organic component of city structure and space layout. Its planning is not only needed to meet the request of public green ground area in person and city green ground rate, but also to achieve the ecological environment effect of planting in terms of limited space and input.

2. The establishment of optimum structure of planting in multiple levels

2.1 Foundation of optimum structure

Whether adopting the way of optimum model calculation or evaluation by analysis, a common theory foundation that is the equivalent numerical relation of ecological environment effect between different trees and different planting types shall be established. The relation has difference to regions and planting types [1]. Planting has ecological environment effect of. However, these effects show difference according to green land types and planting trees. The ecological environment equivalent coefficient shall be calculated according to single effect of modulating air temperature and moisture, equilibrating carbon dioxide and oxygen, purifying the air as well, which is based on a lot of experiment considering the difference of region, planting trees, the age or the structure of planting trees.

2.2 Optimum way of planting structure in multiple levels

Planting system can be described as multiple optimum models of multiple targets for optimizing.

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2.2.1 Optimizing targets

The purpose of optimizing planting structure in multiple levels is to maximum the ecological environment effects. When analyzing the ecological environment benefits, the function of regulating to person and social performance in planting planning is also a factor that can not be ignored. Achievement of ecological benefits can be regarded as optimizing target of planting structure in multiple levels for simplifying research. Ecological performance of planting is: modulating microclimate, equilibrating carbon dioxide and oxygen, purifying the air, reducing the noisy, defending wind, keeping sand, protecting water resources and so on [2]. The establishment of optimizing target depends on different region and actual situation. For example, Chongqing is located in a basin where the weather condition is bad. With the improvement of people living standards, energy consumption by air conditioning system has been increasing year by year. The increasing of population and the development of the city make it a big artificial hot source and produce the obvious" hot island" effect as a result. To improve the weather condition by planting is one aim. Moreover, Chongqing is a heavy industry city. Steel, mechanical, chemical engineering, energy industry etc occupy the important position in economy. So pollution is serious, the bad air quantity is a serious problem for long. It is one of the optimizing targets that use planting to equilibrating carbon dioxide and oxygen, purifying the air, improving air quality. Especially Chongqing is the southwest center of acid rain and the density of sulfur dioxide is high. So function that planting trees resist sulfur dioxide pollution and absorb sulfur dioxide is request.

2.2.2 Constrains conditions

1) Planting area

The related laws and regulations reflect in fields of city planning, city land utilizing, parking design, residential quarter planning, street planting planning and so on. The rations of planting area shall be assured in city planting planning. For example, planting land must cover 30% of total area of residential quarters at least in China. In general, the planting land rate shall be 40-60% in a new region and not less than 25% in transforming an old region [3].

2) The landscape requests and principle

The idea of the architect can be expressed and the mind can also be relaxed and pleased by planting planning. The building outdoor environment is depended primarily on space combination of buildings, building adornment, planting types. Plants are arranged according to the request of sunshine, water, soil. Moreover, the interspecific relations of plants are considered.

3) Sunshine request

Firstly, the ultraviolet ray in the sunlight benefits the health of the body with the function of disinfection, Secondly; the eye is more intelligent under the nature light than under the artificial light [4]. Finally, nature light shall be used in the view of energy efficiency. Therefore, the influence of plant (high and big plants particularly) to sunshine time and sunshine area of buildings is very important to attain the sunshine standard of the indoor in structural layout of planting.

4) Acceptance of pollution

For the respiration of the people and burning the fuel, some amount of planting shall be planned to produce oxygen in cities. At the same time, the density of the harmful gases or materials shall conform to standard. In planting design, acceptance of pollution of the plants in residential region is decided according to peoples, vehicles and other equipments producing pollutions.

5) Function of leading and defending wind

The natural ventilation has a good effect of cooling the building in hot region in summer. It can cool the building. On the contrary, how to prevent the wind will be paid more attention to in order to reduce cool or heat infiltration from buildings in cold region in winter. Therefore, the different request of defending or leading wind shall be satisfied according to local climate, geography factors, the choice and arrangement of plants.

6)The ecological condition for different types of plants

Generally the arbor on the first level is sun species, the sub-arbor on the second level is half-shade species. The bush distributed at exterior can be sun species but bush shaded by the arbor shall be half-shade species. The grass shall has the ability to resist dry and bear to trample, has a longer green period as well [5]. Pipes are intensive on the ground or underground of high buildings, which is an important problem when plants are arranged.

2.2.3 Process of optimizing

According to the analysis above, the optimizing process of planting structure in multiple levels in living

area can be generalized as follows:

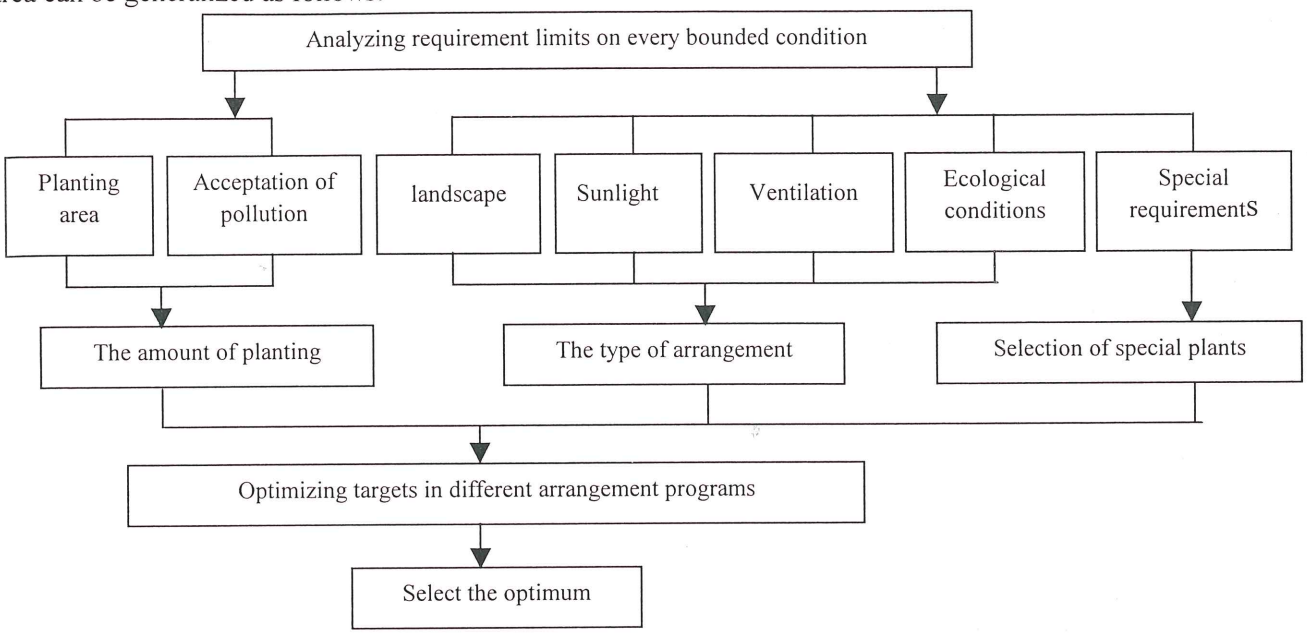

Fig. 1 Flow chart of optimizing process

2.3 Quantizing problems of planting in multiple levels

Planting in multiple levels emphasize using of space level of structure, so the green area in the unit area is increased. The qutification indexes include the area of the arbor, the brush, and the grass, and the LAI (leaf area index) that is a ratio of the leaf area to the land area. LAI can be used to calculate carbon consumed and oxygen produced by plants, and also for deciding decrease of air temperature due to transpiration of plants. Green amount also is an important index because the difference of planting position affects the available leaf area that engages photosynthesis. Green amount,green organism amount in other words, is the available leaf area that engages photosynthesis.

2.4 Design idea of planting in multiple levels

Design of planting in multiple levels expresses the characteristic of "multiple levels" and "three dimensional". Take a residential quarter for example, the planting structure in multiple levels refers to forest and farmland around the city, planting in park, road and bank of the city, and planting in the quarter, indoor planting as well. Apart from the design of grassland and ornaments, planting of building itself which includes wall planting, veranda planting, roof planting shall be emphasized. When using wall or roof planting in hot region, indoor heat gain from sun radiation through building envelope can reduce. Planting in multiple levels can not only improve indoor thermal environment by natural cooling, but also alleviate inefficient green land problem.

3. Conclusion

Planting in multiple levels is a system that be put forward as a kind of ecological green space planning. It shows a planting structure from environment of human settlement to indoor environment. Each level of the structure affects mutually. The purpose of planting in multiple levels is the effective realization of ecological environment effects that is based on effects calculation of all types of planting in different region. In the optimizing process, the rations of planting, landscape request or principle, sunshine request, acceptance of pollution, leading or defending wind, and plant ecological request shall all be considered. The ecological environment effects show localizability and specialty in the different environment. The further research will be very valuable.

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