

STUDY ON VEGETATION RESTORATION AND DESIGN OF THE RE-RELIC/ YUANMINGYUAN

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Abstract:

Yuanmingyuan had been such a big royal botanic garden which full of precious flowers and trees during the prosperity Period. In order to rebuild the Dream-like landscapes, flowers, and unique architectural space in Yuanmingyuan, the “Re-relic/Yuanmingyuan” team had rebuilt the vegetation landscape by research, restoration, design, and 3d space generated based on the research of architectural restoration design. In order to maximize close to Yuanmingyuan garden style in various historical periods, and to show the landscape amenity in different periods, the vegetation landscape research especially focus on the Planting Species and the allocation of Species. First, the project concludes plant species list through searching relative archives and drawings such as “Huaguo shumu jiazhi”, “Yangshilei” drawings, “40 scenes”, “Emperors’ poet”, and plant monographs at the same period; Then, the project accomplished plant detailed design, allocation species combined with rocks, buildings, water, and the overall mood of garden space. At last, it had been carried out in three-dimensional space to adjust the overall atmosphere, and trade off the plants which block the main building according to perfect the main viewing area scene. This paper chose the scene of “Xinghuachunguan” as a case study to introduce the process of planting landscape research.

1. INTRODUCTION

It's well known that, Yuanmingyuan, as “The Old Summer Palace” of the emperors of the Qing Dynasty enjoys high reputation in the world garden history, which has been praised as “A model of all the fantastic art” by the great French writer Victor Hugo. The protection of the “Yuanmingyuan Ruins” has always been the focus of the scholars in China and abroad since 1860 when it had been burned. It is not only for it has a very high social value and historical value, but also for it has reached a highest level in Chinese classical garden design. Moreover it has once been the most beautiful garden in Qing dynasty.

Today, a lot of people in the world know the name of the yuanmingyuan, but they don't really understand the contents of the yuanmingyuan. In other words, maybe they know that there are hundreds of architectural landscape points, countless jewelry in the prosperous yuanmingyuan, but they don't know Yuanmingyuan has been such a big royal botanic garden which has been full of precious flowers and trees .

The role of the vegetation in the Old Summer Palace is very important, not limited to beautify the building, mountain, water, stone, etc., but also to improve the Old Summer Palace and the surrounding ecological environment, as well as to make up the height of the park Hill. So, either research or protection of the summer palace, vegetation landscape can't be ignored.

2. BACKGROUND AND SIGNIFICANCE OF THE TOPIC

In order to better protection and display of Yuanmingyuan, Beijing Tsinghua Urban Planning and Design Institute officially launched the “Re-relic/Yuanmingyuan” research project in June 2009. The project based

on the modern virtual reality space display technology broke the traditional study method of two-dimensional picture imagination and text descriptions. It built an authentic “Digital Old Summer Palace”, displaying the whole evolution of Yuanmingyuan since it was built in 1709, Kangxi dynasty through rigorous building restoration design, vegetation landscape restoration design, and establishment a three-dimensional space. The public can be more intuitive and visual understanding of the level of garden art and the process of development through the outcome of the “Digital Old Summer Palace”, which further enriched the research results on the Yuanmingyuan garden art, and provides more conclusive scientific evidence for the protection of the Yuanmingyuan Ruins.

“Study on vegetation restoration and design of the Re-relic/Yuanmingyuan” is an indispensable part of the “Re-relic/Yuanmingyuan” project. The basic goal is to realize the vegetation landscape maximum faithful to the original history appearance. Vegetation restoration research is based on architecture and landscape topography restoration design and space rebuild. With the decoration of the plants, the whole garden space turns more vivid. For the first time, real plant species materials are used in the 3D scene to make real effect, so that vegetation landscape style of different period during Qing Dynasty can be more comprehensible to the public.

3. RESEARCH PROCEDURES

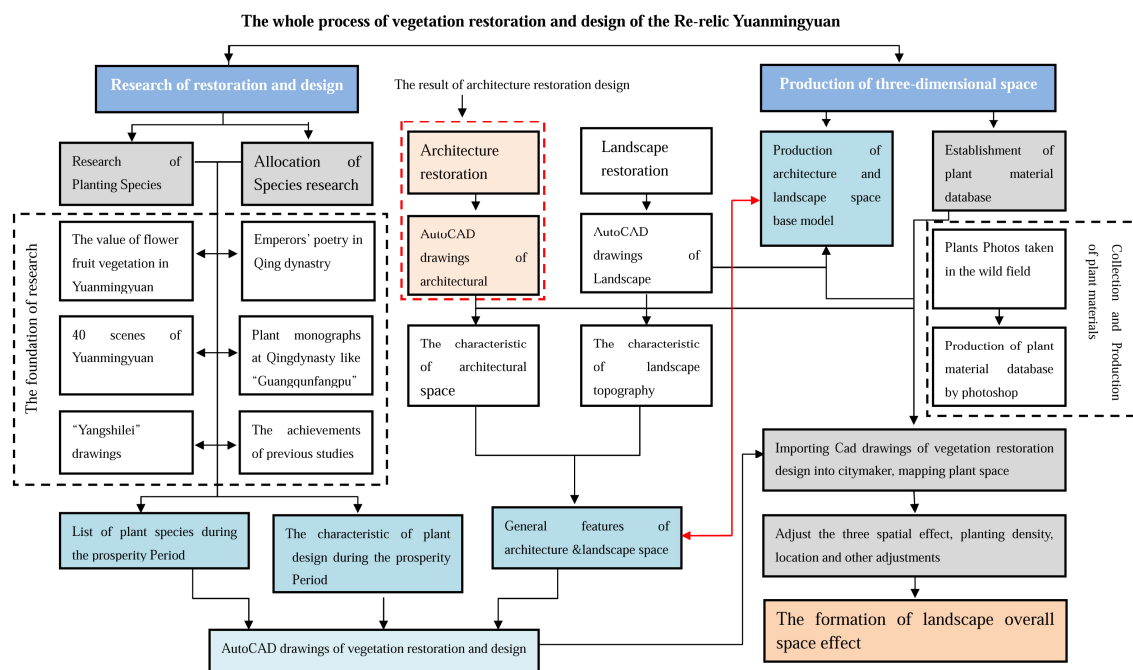


Figure 1: The process of the re-relic/yuanmingyuan vegetation restoration design

The whole procedure of “The vegetation restoration design of the yuanmingyuan” includes three phases: Firstly, study on the varieties of plants and the allocation of Species through searching relative archives and drawings such as “40 scenes”, “Yangshilei” drawings, “Emperors’ poetry”, “Yuanmingyuan neigong zeli”, etc; Secondly, complete the planting restoration design in the AutoCAD; At last, generate a 3D scene in the CityMaker. The former two process need to be interspersed, in order to create a vivid 3D scene, the collection and production of plant materials must be carried out simultaneously with the research of restoration design, to initially establish plant material library. In addition, the architecture and Landscape space modules also must be pre-made. (See figure 1.)

4. MAIN CONTENTS AND KEY POINTS

4.1 Main contents

According to the above research procedure, the first phase, studying on vegetation restoration, and the last phase, generating the plants landscape in 3D scene are two main contents.

The first phase includes two aspects: one is the research on plant species and allocation of species, the other is the vegetation restoration and design. The former is the basis and the difficulty of the whole process for the following reasons: Firstly, there are no plants still alive on the site, so we have to speculate plants variety with drawing data. However, there is very few plants information in the drawing data. Secondly, after many years development, the names of plant species have changed tremendously. Some species in drawing data of the Qing Dynasty, for example, "*Pinus massoniana*", is completely different from nowadays. Lastly, previous study on Yuanmingyuan plants landscape mostly focuses on macro description, so there is little intensive research on the scenic level.

In response to these problems, we take the following measures in selection of plant materials: First, rearrange "The value of flower fruit vegetation" which provided in the "Yuanmingyuan neigong zeli" as a basis plant species list during the prosperity period. Then, speculate plant species of every scenic area with "40 scenes", "Yangshilei" drawings, "Emperors' poetry", and develop the featured plant species list of the scenic. Furthermore, according to the atmosphere, functions and features of every scenic, combined with the imperial garden planting features of Qing Dynasty, select some plants which are able to grow in north China to enrich the scenic space, thus a relatively complete list of scenic plant species has formed.

The following measures are adopted in terms of the allocation of species: First, identify the featured plants in certain space such as architecture surrounding during the early Qianlong period according to "the 40 scenes", "Emperors' poets, etc; Then, according to the characteristic and function of architecture, features of landscape topographical, emperors' daily life and aesthetic in different periods, finish the planting design in other space. The principle of the allocation is to ensure that the atmosphere of the plants landscape in harmony with the architecture, rocks, water and hills.

The last stage makes use of the real plant materials in 3D scene to achieve a better vivid effect. However, owing to software restrictions, when the 2D planting plan is imported into the 3D scene, some questions appeared such as high density in certain part, un-match between the plant height and the site topography, and main building being blocked and so on. (See figure 2 Right above). So in order to realize the original idea of the planting, we must adjust planting effect manually, removing those trees which block the main building, selecting proper plant posture in accordance with the requirements of scenic space, enlarging those small trees or shrinking those too big trees to fit the space, reducing some trees quantity when there are too many, etc. Through carefully adjustment, the eventual renderings of scenic are completed (See figure 2 Right below).

The key point of the process is to guarantee the authenticity of materials and the abundance of plant species. The so-called authenticity of the materials means that to ensure the plant materials pictures used in 3D space be correspond to the selected plant in the plan (AutoCAD). For example, if there is "*Pinus tabulaeformis*" on the plan, so "*Pinus tabulaeformis*" material images must be used in 3D scene and can't be displaced by other materials. Only with the true expression of plant varieties, should the 3D visual effect of plant space be intuitive and real. The abundance of plant species means that a kind plant has many different materials not only in different seasons but also in different ages. For example, there are at least 5-10 forms of "*Salix matsudana* L." prepared in order to avoid a monotonous space. (See figure 2 Left).



Figure 2: Left: Plant materials used in the 3D scene;
 Right above: the planting effect in the 3D before adjustment;
 Right below: the planting effect in the 3D after adjustment

4.2 Key points

1) About the base map

The base map of the planting design includes two aspects: the first one is architecture restoration design which contains the plan, elevations, profiles, and the second one is the Landscape framework restoration design. Through carefully research, the yuanmingyuan architecture restoration design is divided into thirteen periods according to the level of detailed information and the changes of landscape and building layout, and each scenic spots completes different periods according to its own situation.

The landscape topography restoration design is completed refers to the historical “Yuanmingyuan” topographic maps which measured in 1933, 1965 and 2002, “Yangshilei” drawings in different periods of Qingdynasty, the archeology information, and landscape spatial characteristics of the Yuanmingyuan ruins. With the accurate base of architecture and landscape framework, the vegetation landscape restoration design can be more scientific and authentic than any research before.

2) On the historical periods of design

The historical periods of planting design are entirely based on architecture restoration design. For example, in the “Shangxiatianguang” scenic, the architecture restoration includes four periods: Early Qianlong Period, Mid Qianlong Period, Early-mid Daoguang Period, and Daoguang-Xianfeng Period. So the plants design should also include above four periods.

Of all the periods, early Qianlong Period, also called “40 scenes” period, (in Qianlong 9 years, 40 scenes finished) is the most important period of planting restoration design. On one hand, “40 scenes” is the earliest yuanmingyuan colorful drawing spreading in the world, and from which the public can easily capture different features of each scenic spot, main plant materials and plant detailed design; On the other hand, 40 scenes period has been the prosperous period of Yuanmingyuan, the landscape is quite typical among all the historical stage and expresses the imperial ruling ideology and the aesthetic taste in the early-Yuanmingyuan period. In addition, as the vegetation is the only active one of the five landscape elements, plants landscape can maintain a relatively stable state unless it

was forced to change to adapt the changes of architecture space. Therefore, the success of plant detailed design of 40 scenes period laid a basic spatial pattern of plants for the period following, especially plant framework on the landscape framework. If there was no change in architecture space in the follow-up period, in principle, plants landscape can be regarded as unchanged. The later periods plants landscape changes can be found in the minority of “Yangshilei” drawings during the mid-late Qing Dynasty, such as “Jiuzhouqingyan” (See figure 3).

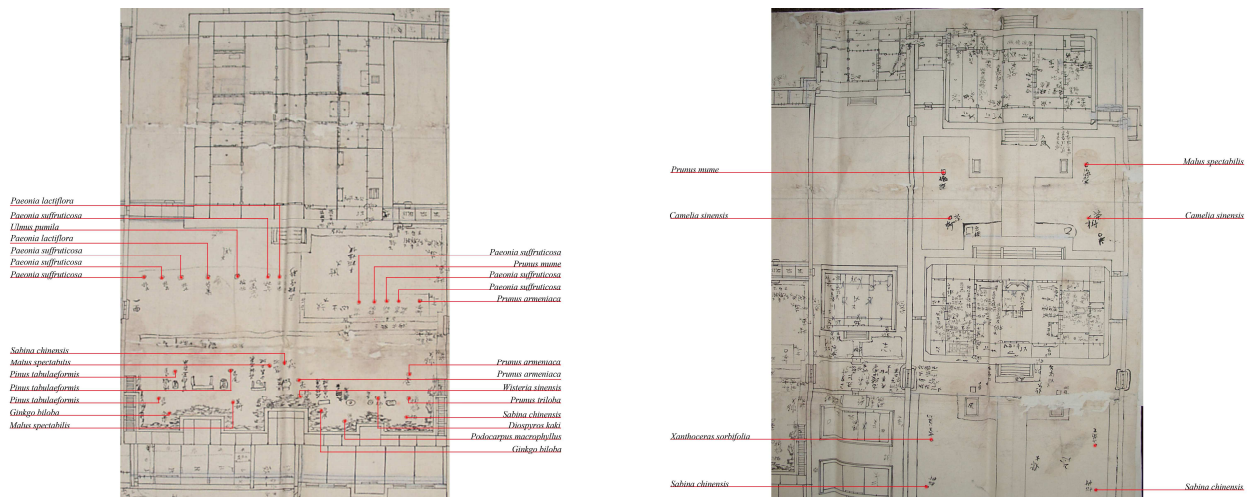


Figure 3: The planting in architecture space of Jiuzhouqingyan scenic in the “Yangshilei” drawing
(After Daoguang 17 years, before Xianfeng 5 years);

3) On the vegetation restoration design of each scene

The vegetation restoration design mainly consists of three parts: the architecture and its surrounding vegetation landscape, which is the focus of each scenic spot; the vegetation landscape on the surrounding mountain; and the water vegetation landscape. The vegetation landscape of architectural courtyard and the surrounding environment is mainly to set off the architectural sites and to create a scenic mood. The vegetation design on the mountain, as a background of the architectural attraction, is designed according to the mountain configuration and trends which strengthens the mountain shape. The water plant landscape includes the waterfront and the water surface. The waterfront greening focuses on selecting wet-land plants to create colorful waterfront landscape; the water surface greening aims at choosing a variety of aquatic plants to arrange with the scenic mood.

5. CASE STUDY ON VEGETATION RESTORATION AND DESIGN OF “XINGHUACHUNGUAN”

We take "Xinghuachunguan" scenic as an example to illustrate the general research process and results.

5.1 Design reference

- 1) **Drawing data:** ① "40 scenes of Yuanmingyuan" ; ② "Yangshilei" drawings, ③ "Penghuchunyong"
- 2) **Archives:** ① "the value of flower fruit trees", ② Imperial poetry of 5 emperors in Qing dynasty
- 3) **Library information:** "The old news of beijing" ② "Guangqunfangpu", etc
- 4) **Archaeological data**

5.2 The landscape space characteristics of “Xinghuachunguan”

“Xinghuachunguan” scenic with an area of 2.1 hectares is one of the largest scenic in “Jiuzhou” area. It is located in the northwestern corner of the Hou-Lake, to the east of “Shangxiatianguang”. (See figure 4)

The main part of the scenic is mountains surrounding around, and the northern hill is the highest peak in the whole Jiuzhou scenic, which is the symbol of the Kunlun Mountains. The buildings and garden are located in

the central valley. The main function of the scenic is for emperors observing the agriculture to flaunt themselves concerning on farming and caring about the civil life.



Figure 4: Left: the location map of “Xinghuachunguan”
Right: 40 scenes of “Xinghuachunguan”

The “Xinghuachunguan” scene architecture and landscape restoration design is divided into two periods, one is the early Qianlong period and the other is Dao-Xian period. There are obvious changes in the architecture layout and landscape structure in these two periods. The scene feature of the early Qianlong period can be got intuitively by “40 scenes” (See figure 4). Together with the “Xinghuachunguan” poets and other related descriptive text, It can be concluded that the overall landscape style of the early Qianlong period is simple but elegant: a few “dwarf house” scattered naturally in the central, a big vegetable garden lies in the eastern, and many *Prunus armeniaca* trees grow near the buildings, the whole scenic looks like a small quiet village.

Till the Dao-Xian period, the landscape structure and mood has been greatly changed. Since Qianlong 20 years, the reconstruction began as follows: digging out the vegetable garden to be a lake, building a canal to link with the Hou-Lake in the southeast, and in the middle of the scenic, the “dwarf house” is reconstructed into a group of courtyards which faces the water on the east and south, the main building is called “Chunyuxuan”, and a small five width temple with cloister – “Jianheyuqing” lies at south of the courtyard, as the entrance attractions .In Qianlong thirty-four years, rockeries has been piled at the back of “Chunyuxuan” to make it the peak of the mountains around Hou-Lake. So far, the scenic has become a completed garden landscape. Each period of scenic status is shown in figure 5.



Figure 5: The change of buildings and landscape structure of “Xinghuachunguan”

Left: during early Qianlong period; Middle: during Dao-xian period;
Right: the bird view of Xinghuachuynguan during the early Qianlong period and Dao-xian period

5.3 Plant species research and plant design in “Xinghuachunguan” scenic

1) Plant species research

First, according to 40 scenes, speculate the plant species on the drawing as the characteristic plant species in the early Qianlong period; Next, supplement the plant materials, such as “wheat” according to the plant species mentioned in Emperors’ poetry; Finally, choose other plant species in accordance with the scenic atmosphere, such as walnut, flowering peach, so that to fix the list of plant species during the Early Qianlong Period (See table 1, figure 6).

Table 1: the research of planting species in the early Qianlong period

Scenic	Season feature	speculated plant species from the 40 scenes	speculated plant species from poetry	speculated plant species from Yangshilei drawing	Select plants from the traditional landscape design
Xing hua chun guan	spring	Evergreen trees : ChinesePine、China Savin. Or Taiwan Juniper Deciduous trees: hankowwillow、weeping willow、 Aucuparia. Or pagoda tree、 Pecano、 Dateplum Persimmon、 Aesculus、 winterberry cuonymus Deciduous semi-trees: Prunus armeniaca Flower shrubs: Weeping Forsythia	Wheat	None	Evergreen trees : ChinesePine、 China Savin. Or Taiwan Juniper Deciduous trees: hankowwillow、 Aucuparia、 pagoda tree、 Mono Maple、 Pecano、 Dateplum Persimmon、 CommonSmoketree、 Aesculus、 Birchleaf Pear、 Chestnut tree、 Elm、 Paper Mulberry、 winterberry cuonymus Deciduous semi-trees and Flower shrubs: White Flowering peach、 Hawthorn tree、 Prunus、 Prunus armeniaca、 Siberian Apricot、 Flowering peach、 Elder Flower、 Peking Mockorange

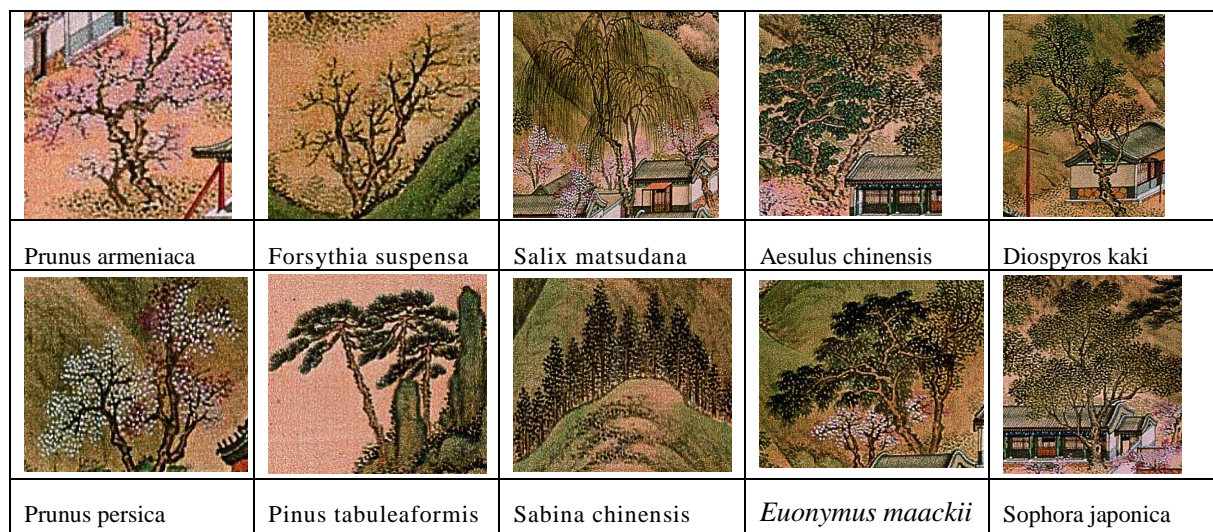


Figure 6: Speculate plants in the 40 scenes of “Xinghuachunguan”

During Dao-Xian Period the plants landscape integral atmosphere is more gardening than that in the Early Qianlong Period, wheat and vegetables vanish with the vegetable garden disappearing; In the main courtyard, add some plant species such as magnolia besides keeping apricot as the backbone tree species, to enhance a courtyard garden atmosphere; Supplement some resistant wet plants such as iris, and aquatic plant lotus surrounding the new lake. Generally keep the original mountain plant variety, and add some characteristic plants just surrounding the newly increased rockery at the east of water, such as winter jasmine etc.

2) Plant restoration design

The plant restoration design of the Early Qianlong Period is based on the “40 scenes”. Firstly, guarantee a relatively full embodiment on the characteristic plant landscape of the drawing, such as apricot and vegetable garden around the architecture. Secondly, take a reasonable configuration on the peripheral plant combined with the demands of terrain characteristics and view borrowing, and make a perspective view corridor on the

Hou-Lake at an area just outside the “Chengguan”. (See figure 7).The plant detailed design during the Dao-Xian Period focused on change some plants, exclusion or shift to adjust the change of architecture space, and at the base of the overall landscape mood of “the apricot village” to redesign the new increased courtyard, water and rocks surrounded, and finally form the plants landscape effect. (See figure7).

5.4 The vegetation landscape effect adjustments of “Xinghuachunguan” scenic in the 3Dspace

According to the 40 scenes of Xinghuachunguan, the typical plant landscape is spring in the Early Qianlong Period. So choose plant materials to emphasize the seasonal characteristics. At the same time, through adjusting the trees height, density, and posture in the 3D, to form the last beautiful effect (See figure 7).The same method is adopted in Dao-Xian period, and the effect after adjustment can be seen in figure 7.

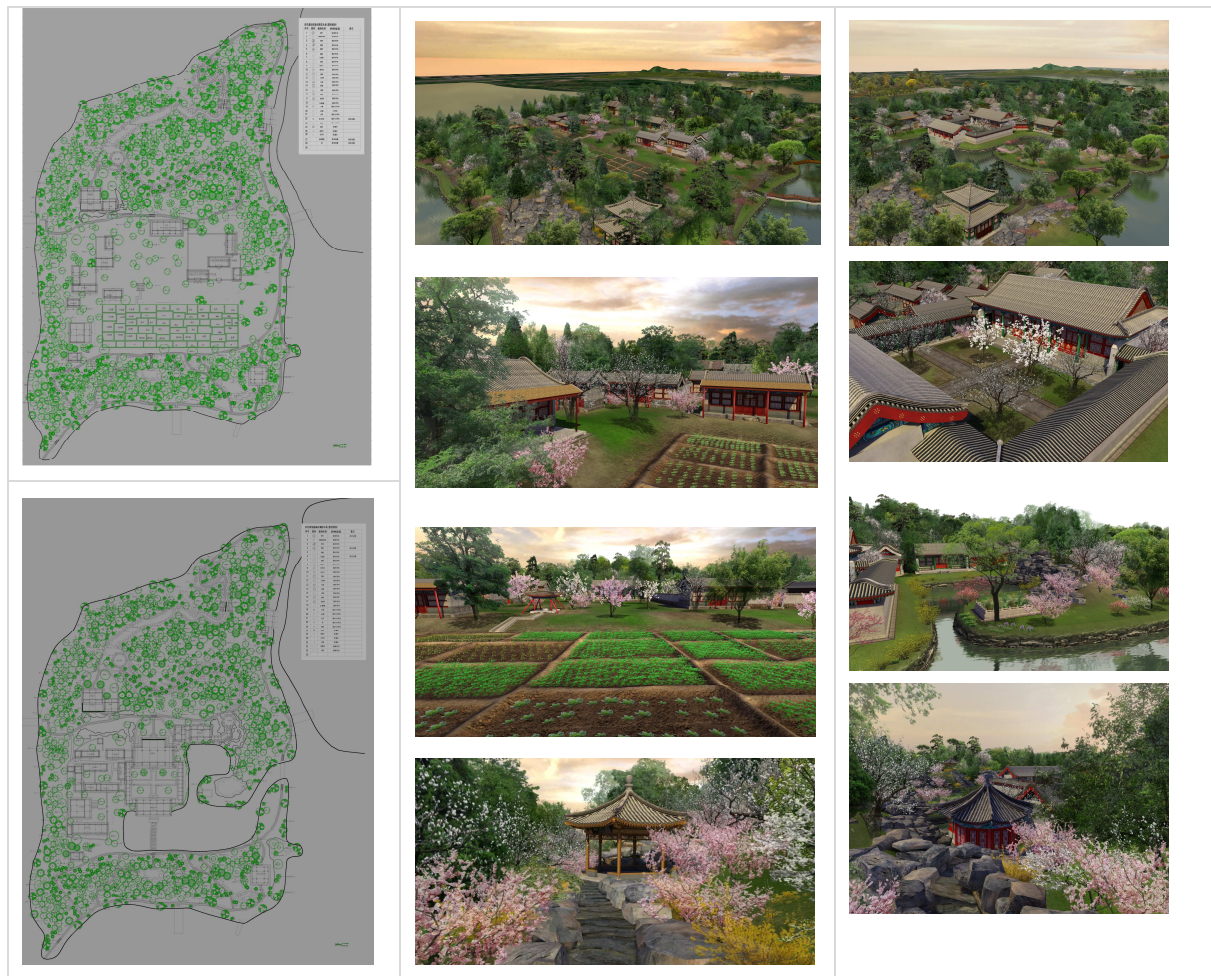


Figure 7 : Left: The planting plan in early Qianlong period (above) and in Dao-xian period(below);
Middle: the garden early Qianlong period; Right: the garden effect in Dao-xian period.

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