
A Display of Fengshui with Aerial Panoramic Roaming technology —— Using the Eastern Qing Tombs as an Example

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Abstract: Fengshui, an ancient art of placement, is not a superstition but an ancient Chinese ecological concept and landscape architectural theory. The theory played a key role in city planning and building in various dynasties. In particular, it endowed imperial complexes with supreme artistry and cultural taste. Even to this day, we cannot help but marvel at the majestic palaces, the solemn mausoleums, the awe-inspiring castles and the prosperous villages. The Eastern Qing Tombs are one of the classic works of Fengshui theory. The emperors, together with Fengshui officials and philosophical architects not only collectively created a 10km front ring of landscape, but also compared the 50km mountain range (from Wuling Mt. to the front ring) to Long Mai (the dragon vein). The engineering feat fully embodied the grand power of ancient Chinese emperors.

Due to their huge scales, the landscape architectural accomplishments, which represent the essence of Fengshui, are hard to put on display for public appreciation. Ancient emperors embraced a vast territory, so it is natural that their tombs' Fengshui system stretches scores of kilometers. The super-scale landscape axis (Long Mai) and the Fengshui thoughts were keenly felt by ancient people, but are lost on today's tourists who visit the sights for only a couple of hours. In view of this, the author uses UAV fixed-point panoramic shooting to convert abstract Fengshui concept into concrete images, creating a panoramic roaming system for imperial tombs' Fengshui, the first of its kind in the world. Thus visitors can soar over the entire landscape within minutes and fully appreciate ancient Chinese landscape architectural achievements.

This paper introduces the Fengshui system of the Eastern Qing Tombs, aerial panoramic shooting method, result indexes and public broadcasting channels. It also analyses the major differences in display effect between low-altitude panoramic roaming, ground-based panoramic shooting and Google Earth 3D data. This article also summarizes shooting experiences and problems so as to promote the application of this technology in architectural heritage field and reveal the potential value of these heritages to the whole world.

Key words: Fengshui, imperial tombs, unmanned helicopter, aerial panoramic roaming

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1 INTRODUCTION

The Eastern Qing Tombs were the first royal mausoleum of the Qing Dynasty built after it had dominated the

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Central Plains. Starting from emperor Shunzhi's Xiaoling mausoleum in 1661 to the completion of Empress Cixi's Dingdongling mausoleum in 1908, the construction lasted two and a half century, with over 580 buildings in which were buried five emperors, 15 Queens as well as many imperial concubines, princesses and princes of the Qing Dynasty. The Eastern Qing Tombs exist as the grandest and most complete imperial mausoleum complex in China's and have been included in the World Heritage list.

At imperial mausoleums, visitors can appreciate funerary objects, coffin chambers, architectures and landscape. At the micro level, for historical reasons, the funerary relics have suffered heavy losses, hence there are not many to display. The coffin chambers are currently the main part of the exhibition, intriguing visitors with their mystery. That explains why Dingdongling and Yuling mausoleum are the most frequently visited underground palaces. However, mystery is not enough to intrigue visitors. The Eastern Qing Tombs, the overall planning and the surroundings should also be showcased. But a macro display like this may encounter some problems:

1. Grand as the Eastern Qing Tombs are, the respective mausoleums bear small differences and are sparsely distributed, hence not as attractive as the other palaces and ornamental gardens in Beijing. A mausoleum complex alone is not attractive enough for visitors.
2. The tombs are distant from each other. Wandering on the long, non-mysterious divine road, visitors get tired and bored easily and may lose sight of the overall picture.
3. Visitors with a tight schedule are unable to see all the mausoleums, which is a waste of resources.

In fact, the main feature of the Eastern Qing Tombs is represented not by the coffin chambers, but by the overall planning and surrounding landscape, namely, fengshui, a philosophical concept running through the whole process of planning and architectural design.

This is a painting(Fig. 1) of *The Fengshui of the Eastern Qing Tombs*, stored in the National Library. It was drawn by the royal architect Ray family when Emperor Guangxu selected Emperor Tongzhi's HuiLing mausoleum in the first year of his reign, showing the Fengshui of the Eastern Qing Tombs with a freehand landscape painting technique. From this painting, we can see the original grandeur of the Eastern Qing Tombs, which covered not only the 70-square kilometer front circle, but an area of 2500 square kilometers. According to Fengshui theory, ancient Chinese settlements should have Chaoshan and Anshan mountain in the front, the main mountain, Shaozu mountain and Zushan mountain in the rear to form a complete Long Mai (the dragon vein), which is part of the philosophy of achieving harmony between man and nature. Besides, the beauty of the landscapes can inspire future generations to keep the memory of their ancestors, just as Sima Qian once said: "A man with high morality arouses strong admiration in me just as looking up at a mountain; I may not achieve the same moral heights, but my heart is always yearning."

In addition to the overall planning, Fengshui theory plays a guiding and decisive role in the designing of the main divine road, Tangju (the Fengshui pattern formed by houses, tombs and the surroundings), the micro-topography for each mausoleum as well as the various construction details. For example, standing at Xiaoling Gate and looking towards Xiangdian Palace, we can see the well-designed framed scenery made up of the sparrow braces on the Gate and the rooftop of the Xiangdian Palace, a manifestation of the Fengshui theory. It can be said that Fengshui, when removed of its superstitious content, is actually an ancient Chinese landscape architecture, which finds its highest manifestation in the building of the Eastern Qing Tombs. Here architectures

fit perfectly into the natural environment, which not only reduces the difficulty of the construction, but also meets the ritual needs, showing the wisdom of the Chinese people. All these should be shown to the public. However in our research we find that apart from the underground palaces, most visitors think other relics and landscapes unattractive, which shows that they are not fully aware of the connotation of the Eastern Qing Tombs. The reasons are as follows:



Fig. 1 Fengshui painting of east tomb Fig. 2 well designed framed scenery Fig. 3 East tomb on Google Earth

1. The super-long axis causes visual communication difficulties. The divine road alone extends 6 km. Simply by visiting above ground, visitors cannot get a spatial impression of the grandness and completeness of the Eastern Qing Tombs and therefore cannot fully understand the creative overall planning of the architects. Nowadays air tour for visitors is still unrealistic.

2. It is impossible for visitors to do a survey of the 2,500-square kilometer rear dragon like the Qing tomb-building officials did. This super-scale, relatively subjective and abstract Fengshui map is difficult to fit in with modern satellite images (Fig. 3). Now very few people have access to the original map, which makes it even more difficult to understand and appreciate the vision and ambition of the emperors over the landscape and to match the map with the real thing. 3. People have limited and false understandings about Fengshui. Due to historical reasons, people regard Fengshui as superstition rather than landscape architecture. Without professional explanation, visitors may turn a blind eye to the key points along the divine road, attracted only by such visualized objects as stone figures.

For the above reasons, although the Eastern Qing Tombs and surrounding landscapes are well preserved to this day, the unique and precious heritage of Chinese nation - fengshui is hidden and fails to engage tourists' interests. In 2011, the Eastern Qing Tombs have 2.7 million monthly visitors, while over the same period the Imperial Palace receives nearly 1.1 million people, 40 times the number of the former. If fengshui and underground palaces can be shown visually to the public, the number of visitors has great potential for growth, given China's large population.

2 DISPLAY SOLUTIONS

Satellite photos can hardly meet the display needs in terms of vividness, resolution and shooting angles(Fig. 3) while air tour costs high, so the author used unmanned helicopter to shoot aerial panoramic photos and made virtual roaming system to realize interactive display at the visitor center.

Unmanned helicopter (Fig. 4) helps to obtain aerial images at low costs. The photos taken have high resolution and extreme low-altitude shooting is relatively safe.

The author will not elaborate on panoramic roaming since it is now a widely used display mode. The innovation of this project is to obtain aerial perspectives, combine aerial with ground panoramic roaming to produce a new display result. With 50 shooting spots(Fig.5), visitors can have a comprehensive perception of the mausoleums, the front circle and the rear dragon. In terms of shooting and production methods, the key points are as follows:



Fig. 4 Turbine helicopter Fig.5 shooting points in the Front Circle Fig.6 tomb of KangXi's concubines

1. All the shooting should be completed within the two months in summer so as to ensure the harmony among pictures. The shooting should be done between 9 and 15 o'clock to avoid abrupt changes in shadow, light and shade.
2. Each panoramic photo is made up of 20 pictures taken from different angles and synthesized seamlessly. In the shooting, the helicopter rotates around its own axis, which imposes strict requirements on its positioning accuracy and working stability.
3. Shooting spots should be selected according to the Fengshui theory. For example, the inward shooting from Xiaoling Gate may reveal its Fengshui distinctly.
4. Each mausoleum, major or minor, should be photographed, especially those less visited by tourists for lack of time. (Fig.6)
5. The display of panoramic roaming images should be combined with dynamic aerial video, commentary, maps, satellite photos and other data. (Fig.7)

2 THE CHARACTERISTICS OF PANORAMIC ROAMING RESULT

After a half-month shooting and two-month post production, the author finished the aerial panoramic roaming system for the Eastern Qing Tombs, which includes panoramic images, professional commentary, background music, aerial video, maps and data, achieving landscape display purposes. The thesis will introduce the characteristics of panoramic roaming results in descending order.

1. The dragon vein is visually presented in front of the tourists.

An aerial panorama shows that the rear “dragon” of the Eastern Qing Tombs looks really like a dragon(Fig.8). The mountain ranges are shaped like the skeleton of a vertebrate. Is it because the Qing officials saw this

landscape when choosing the site of the tombs that they established it as the dragon vein? Even the author did not expect that the dragon vein ranges could be shown so vividly. People should have no difficulty in understanding it.



Fig 7. homepage of panorama roaming system Fig.8 mountain shaped like skeleton of a vertebrate

2. It offers an overview of the spatial location of the respective mausoleums and their subordinative relations.

It is important to relate the mausoleums to one another. This would give visitors a complete spatial impression of the mausoleums and help visitors to better understand the feudal hierarchy. For example, Xiaoling mausoleum occupies the best ridge of the main mountain Mt. Changrui, while Xiaodongling mausoleum is backed by a minor ridge next to it, and the descendants' mausoleums lie further away from it.

3. It reveals the relations between the mausoleums and their micro terrain.

Fengshui theory holds that the best micro-terrain environment is a mausoleum encircled by sand hills which extend from the back mountain. Is it the case of the Eastern Qing Tombs? In aerial panoramic roaming one can see this characteristic clearly. Dingling mausoleum is the most typical example. (Fig.9)

Another advantage is that an unmanned helicopter can reach as low as an eave to shoot a yard or a single building. Aerial panorama at this height can be synthesized seamlessly with ground panorama.

4. Ground panorama “freezes” and highlights the key spots on the touring route.

For example, shooting southwards from north of the archway on the divine road, we can freeze the scenery formed by the archway and Mt. Venus. Shooting northwards from Dingling archway, a tablet pavilion on the divine road happens to appear in the door frame. All these are classic works of mausoleum landscape.(Fig.10)



Fig. 9"Xue" of Ding Tomb Fig.10 shooting from the archway Fig.11 tablet pavilion in the door frame

Overall, compared with other data, aerial panoramic roaming has the following inherent technical advantages, which can meet the needs of Fengshui landscape display.

1. From any of the aerial viewpoint, visitors can get a full view of the landscape with no blind spot and can thus develop a complete spatial impression.
2. A variety of media such as pictures, videos, drawings, words and sound can be integrated to present the object.
3. The aerial panoramic roaming is interactive. It can meet the needs of dynamic browsing. Thanks to its high resolution, images can be displayed on the big screen at visitors' hall or compressed, transmitted or played back on the Internet.
4. Compared with the manual 3D modeling and animation, aerial panoramic roaming is real, easy to make and simple to play.

The current panoramic roaming results have some deficiencies.

1. Files are usually large while internet transmission speed is limited. Each viewpoint file is about 60M; all files add up to more than 300M. However, domestic Internet transmission speed cannot meet the needs of offsite virtual roaming. To increase the transmission speed, we have to compress images and lower resolution. Maybe with the popularity of the fiber-optic network, this problem will be alleviated.
2. The number of viewpoints can be further increased. In addition to providing an overview of the mausoleums, the author intends to record Wenshou (animal ornament on roof ridge), carvings, ornamental design and other key details, so as to present the artistic charm of the Eastern Qing Tombs in a comprehensive way.

3 CONCLUSION

In conclusion, the aerial panoramic roaming system for the Eastern Qing Tombs is the first attempt in China to combine new technology with the traditional architectural theory. We expect to show visitors a vast landscape of over 2000-square km from the front circle to the rear dragon; the architectural art, burial philosophy and construction process. We hope visitors can understand the wisdom of ancients, the great ambition of emperors who embraced vast landscape and the true meaning of imperial mausoleums' Fengshui. We hope that wherever they are, people will have access to the Eastern Qing Tombs. Now the display equipments at the visitor center are under debugging, the real effect is yet to be researched on.