REMOVING SILT IN A CITY USING A DREDGE PIPELINE–A NEW WAY OF USING WATER POWER

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ABSTRACT

A traditional way of clearing silt from city lakes was to carry the silt to an abandoned dust field in an urban area using trucks. This paper describes a new way, using water power and a dredge pipeline to remove the silt that could result in reducing pollution on city roads, shortening the time taken for any project and making a saving on cost outlays. Making use of water power to dredge the silt in city lakes is therefore of great value.

Keywords: City lakes, Nanjing, dredging, restoration projects

INTRODUCTION

Nanjing is located in lower reaches of the Changjiang River, north latitude 31' 14 " ~ 32' 37 ", east longitude 118' 22 " ~ 119' 14 ". Goujian, the King of Yue in the Spring and Autumn period who killed Wu, founded the city in A.D. 472 and started the city's history. Sun Quan, King of Wu moved the capital to Nanjing from 229 AD, until the Republic of China made Nanjing the capital of 10 feudal dynasties with rich cultural heritages. On April 23 1949, Nanjing was liberated and became the central authority for a People's Government municipality directly under the Central Government. Nanjing is provincial capital of Jiangsu at present.

Xuanwu Lake is an important part of the Zhongshan landscape, a state-level scenic area in the ancient capital city of Nanjing. Lying to the Northeast of Nanjing the lake has five isles in the lake – Liangzhou, Circular, Water Chestnut, Green Jade and Cherry Blossom isles that are connected by bridges and causeways. Xuanwu Lake and Zijin-Mountain provide magnificent scenery.

Xuanwu Lake (Figure 1) belongs to a small natural shallow lake system in the city river with an area of 33.08 square kilometers. The surface of lake itself covers an area of 3.8 square kilometers. When the water surface altitude is 10.00 meters (Wu Song elevation), the mean depth is 1.14 meters with a maximum depth of 2.0 meters and a storage capacity is 4.29 million m^3. The highest water level of Xuanwu Lake is 11.15 meters, and lowest water level is 9.8 meters with a common water level of 10.00 ~ 10.20 meters. Water levels when the lake is under control are: flood period, 10.30 meters, ordinary time 9.80 ~ 10.20 meters. The population of Xuanwu Lake area is about 175,600.

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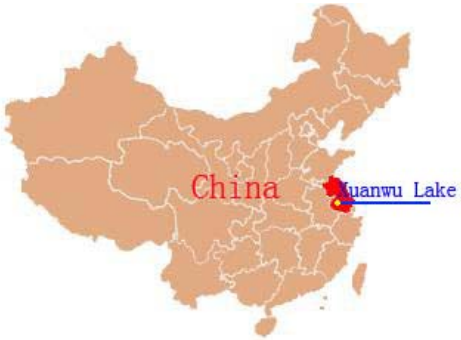

Figure 1. Location of Xuanwu Lake in Nanjing of China.

CAUSE OF PROBLEMS WITH XUANWU LAKE

With the development of Nanjing, the population of the city has been growing quickly for many years with the ecological environment in the river area experiencing gigantic changes. The water quality has increasingly worsened with continuous eutrophication of the water. The need to adopt measures to deal with this problem as soon as possible became important. Relevant departments and units within the government had already paid much attention to this problem, made proposals to resolve it many times and carried out experiments and studies prior to the launching of the Xuanwu Lake comprehensive treatment project. The arrangement according to the government was for the Public Bureau of Nanjing to join in the programming of the Xuanwu Lake treatment.

The government of Nanjing decided to start work in October, 1997 in order to fundamentally solve the problem of the Xuanwu Lake pollution. This resulted in the Public Bureau of Nanjing bringing forward four big schemes for the comprehensive treatment, namely: dredging the silt, damming the river in order to carry out "foul water treatment", general cleanup and the building of a suitable lake ecosystem. Every effort was made to reach the desired targets using technology that was feasible, economic, rational, and of benefit to the community.

ARGUMENTATION OF TREATMENT PROJECTS

The Nanjing Municipal Engineering Design Institute brought forward a design plan for the Xuanwu Lake comprehensive treatment engineering and a consultation meeting in relation to the Xuanwu Lake was held on October 18, 1997 to explain the design plan relating to the "dredging engineering" for the proposed comprehensive treatment for Xuanwu Lake. Relevant leaders and experts were invited to come from Hohai University, Chinese Academy of Sciences Nanjing, Geographical Feature Lake Research Institute, Channel Administration of Nanjing-China, Channel Administration of the Changjiang River, Nanjing Municipal Administration Designing Institute, Draining Administration of Nanjing China and the Nanjing Municipal Engineering Bureau. According to investigations that had been made, the mud thickness in the north and southwest Lake was about 0.5 meters and 0.8 meters in the southeast Lake. The total amount of material to be dredged was 2.34 million m^3. From the quantitative analysis of the sludge, a 0.15 meter thick surface sludge layer in the lake had been contaminated and needed to be cleared away. Below this 0.15 meter thick surface layer the sludge had not yet been contaminated.

Scheme One

All of the lake to be drained before dredging commenced. After the lake water was drained off, dredging with tracked digging machine would commence. Silt would be carried to a truck on a landing stage erected in the lake, using a conveyer belt. The truck would then carry the silt out of lake to a suitable disposal area. In order for the digging machines to work all sludge would have to be removed. The cost of all of this work would be 1.173 billion Yuan of RMB.

Scheme Two

The entire lake region would be divided into three Lake areas (Figure 2); southeast, north and southwest. These would be drained off and dredged in turn. The general method of operation was to be the same as scheme one. The cost of this scheme was about 1.146 billion Yuan of RMB.

Scheme Three

To erect a floating bridge in the lake thereby reducing the difficulty of erecting a landing stage with steel tube in the lake. The general method of operation would be the same as in scheme one. The cost of this scheme was about 1.33 billion Yuan of RMB.

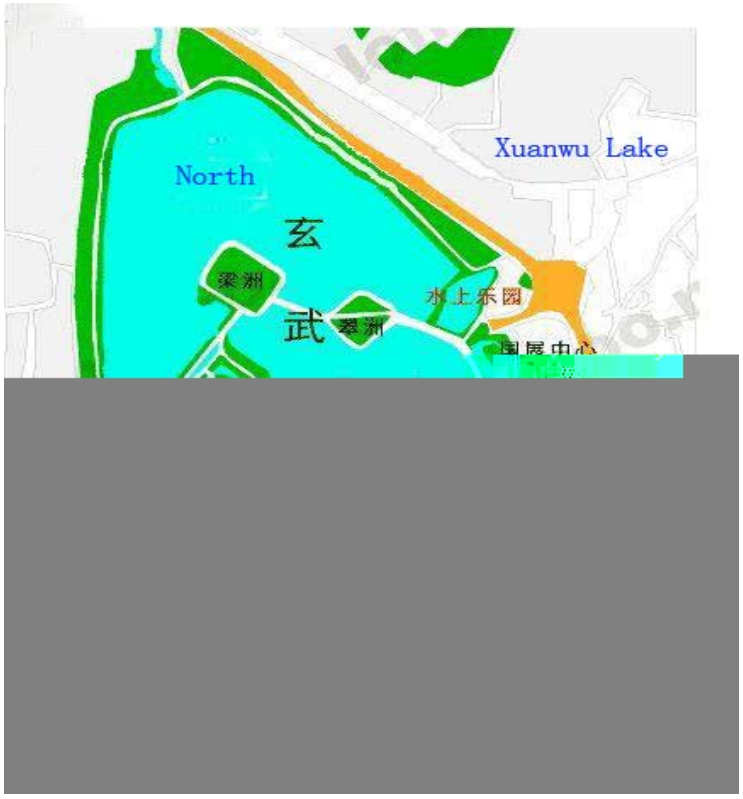

Figure 2. Sketch map of three areas worked in Xuanwu Lake.

All the above three schemes involved the thorough clearing of the silt. However, the time for the project would be long and the total cost figures were not ideal. The experts who participated in the conference carried out a conscientious discussion on the problems of the above-mentioned schemes such as the feasibility of project, construction methods, time factors and the cleaning up of sewage causing the pollution problem. The experts discussed both the advantages and disadvantages of the two schemes that involved (1) dredging with a dry pond, using trucks to carry the silt away and (2) silt is deposited in a pile by the dredger, to be carried out by trucks.

REFORMATION OF THE SCHEME AND THE ADVANTAGES OF THIS

The author participated in the experts consulting conference and brought forward the innovative project idea of removing the silt using pipelines. Simply put, the silt of Xuanwu Lake would be diluted and then removed by dredging using pipelines. The scheme was regarded highly by the experts in the conference and subsequently adopted by the decision-making department.

During the construction, the southeast Lake and north lake were dredged with a dry pond. The southwest Lake adopted the method of removing the silt using dredger with silt pipelines being used to carry material to unused ground in the suburbs. Because of the long distance, to ensure that there are sufficient flow rates to the pipelines terminal, the pipelines had one pump station installed.

The advantages of the scheme that were adopted were that there was no need to consolidate the road and bridge from the lake region to the vacant silt placement ground. Also, urban traffic would not be influenced by the construction work. The scheme decreased the contamination on city roads and kept Xuanwu Lake Park tourism functioning during the course of the construction. This scheme also shortened the time taken for the project, and saved on costs. Because of adopting waterpower to facilitate the dredging the construction decreased the influence on the urban environment and produced highly important social benefits.

Also because there was no digging by machine in the dry only a 0.15 meter thickness of silt needed to be removed. This was much better that the other means of construction involving the taking of a 0.25 meter thickness of silt. This meant that the total amount of the engineering work was reduced to 950 thousand m^3, a decrease more than 1 million. The investment for this part of the project was about 60 million Yuan.

The Xuanwu Lake dredging project started on December 20, 1997, and finished on April 28, 1998. Southeast Lake and the North Lake adopted dredging in the dry with trucks to carry the silt. The Southwest Lake adopted the method of removing the silt deposition in a pond by dredger then pumping to a suburban site by pipeline. The actually final amount of silt dredging was 870 thousand m^3, with the final account of project investment of 50 million Yuan.

Along with other factors, adopting this scheme enabled authorities to save about 10 million Yuan on the overall cost of project

CONCLUSION

City lakes and a lot of the rivers flowing through cities are confronted with periodic dredging problems. So there is usually a confrontation between the construction work and the regular life of urban residents. Adopting waterpower to dredge and removing any silt using pipelines has overcome this above-mentioned confrontation. A scheme such as that described here decreases urban road contaminating, shortens the time required for the project and saves on the investment costs for the project. Dredging using waterpower and the removal of silt by pipeline is of great value when considering any future of city lake dredge engineering.