



Analysis on Water Consumption and Water Saving Potential in Primary School Campus

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Abstract. Urban schools are main water consumers. It is of great significance to study the change of water consumption and water-saving potential. Taking a primary school as an example, by analyzing the water use and water-saving measures of the school, it is pointed out that there are some problems in water-saving work, such as the waste of tap water used by students and the loss of water leakage caused by the frequent damage of water appliances. Then, some water-saving measures such as increasing unconventional water utilization, strengthening water consumption monitoring and strengthening water-saving publicity and education are put forward. After taking the above measures, the per capita water consumption is lower than the advanced value of water quota for a long time, with obvious water-saving benefits.

Keywords: Water Consumption, Water saving Potential, primary school campus

1 Introduction

Water is the source of life, the essence of production and the basis of ecology. It is also an essential element for a better life and high-quality development. In recent years, the state has increased policy and financial support to carry out water-saving society and water-saving city, and remarkable results have been achieved. Water-saving campus is an important part of water-saving society and water-saving city. The construction of water-saving campus is not only conducive to water conservation, but also can enhance the water-saving consciousness of the whole society.

Some scholars have studied the water consumption characteristics and water-saving potential of domestic schools. SHU^[1] discussed upgrading water-saving appliances, establishing a big data remote monitoring and management platform for the water usage system, building a rainwater collection and utilization system, and installing remote water meters in each major water-using unit of the campus. SUN^[2], LIU^[3], QI^[4] and ZHAO^[5] studied the water-saving potential of schools from the aspects of construction, management, conservation awareness and unconventional water resources utilization.

At present, most schools pay more attention to water-saving work. Even in the south water rich areas, many schools have formulated and implemented a series of water-saving measures, but the problem of campus water waste still exists. The following will

take a primary school in Jinhua City, Zhejiang Province as an example to explore the change of water consumption and water-saving potential of primary schools, analyze the causes of problems, fully tap the water-saving potential, and provide reference for campus water-saving work in combination with engineering and non engineering measures.

2 Basic Situation

The school is a primary school. The school covers an area of 42 mu and a greening area of 700m² (efficient and water-saving sprinkler irrigation is about 600m²). There are 80 teaching classes, more than 3400 students and 178 teachers. The school has five student teaching buildings and a canteen. There are 76 faucets, 14 drinking fountains, 47 mop pools, 29 urinals and 159 squatting toilets. The school water is all municipal tap water, with a total of 1 primary water meter and 11 secondary water meters. The main domestic water of the school is teaching water, experimental water, auxiliary water and domestic water. Among them, teaching water is mainly used for toilet flushing, toilet, environmental cleaning and direct drinking water dispenser; Auxiliary water is canteen water and boiler make-up water; Domestic water is used by the guard, etc.

Through field investigation, the waste of tap water used by students is still quite serious. At present, there is no charge for the use of tap water, and the waste of students in water activities is serious. Students often turn on the tap during hand washing and experiment. Water utensils are damaged during use, with serious leakage. The poor quality of some faucets and toilet flushing valves, coupled with frequent use by students, leads to high damage rate, continuous water leakage after damage and large water loss. Students often turn on the faucet to the maximum after the school occasionally stops water supply, resulting in the faucet running out all the time after the incoming water, resulting in a large waste of valuable water resources.

3 Water Structure

Campus water mainly includes teaching water, canteen water, cleaning water, irrigation water as shown in Figure 1. There are 337 water appliances in total, all of which are water-saving appliances. Teaching water accounts for the largest proportion, and canteen water is second only to teaching water. Teaching water and canteen water account for more than 85% of the whole water consumption of the school. Water for other parts includes water for greening and campus cleaning.

Through the installation of 12 water meters in the main pipe and branch pipe, it is used to count the teaching water, canteen water, cleaning water and irrigation water.

As can be seen from the sketch map of water use link, water source: all kinds of water sources for water supply, including water supply pipe network and natural water bodies such as reservoirs, ponds, lakes and rivers. Pipe network: the pipeline (including its supporting buildings) that transmits the water taken from the main water intake to the water distribution valve. Main water consumption places: experimental building, dormitory building, teaching building, etc.

The proportion of water consumption is shown in Figure 2. The average daily water consumption is 96m^3 , and the water consumption in weekends is significantly reduced. The teaching building and Complex building account for the largest proportion of water consumption, about 70%, followed by the canteen, about 20%, and other water consumption (greening, car washing, guard room, etc.) accounts for about 9%.

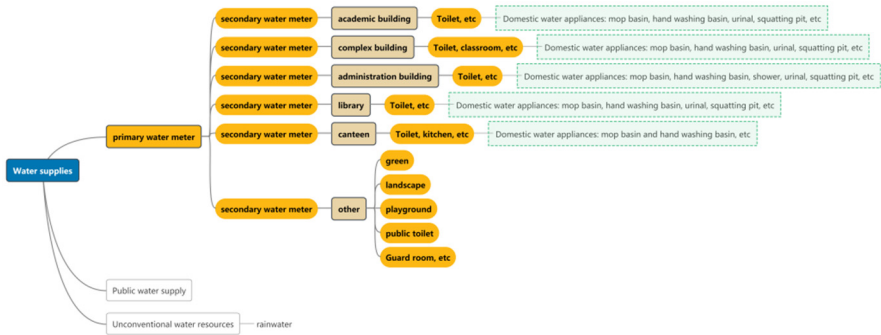


Fig. 1. Schematic diagram of school water intake

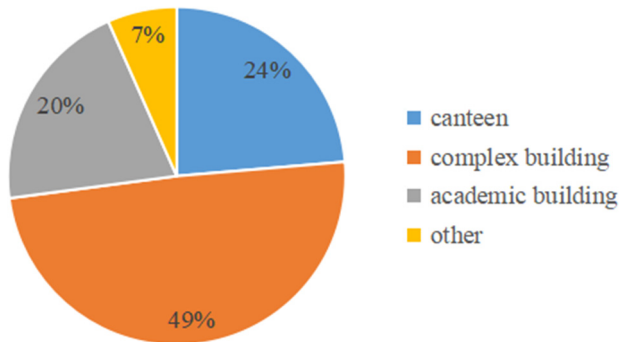


Fig. 2. Proportion of water consumption

4 Change of Water Consumption

The change of water consumption in recent three years is as follows: the water consumption in 2020 is 28258 cubic meters, the water consumption in 2019 is 25087 cubic meters, and the water consumption in 2018 is 19005 cubic meters. The number of school water users is 3590 in 2020, 3285 in 2019 and 3260 in 2018. The unit water consumption of the school can be calculated according to the water consumption and number of water users of the school in recent three years, which is less than the advanced value of water quota. The specific data are shown in the table 1 below.

Table 1. Unit consumption of the school in recent three years

Year	2018	2019	2020
Water intake (m ³)	28258	25087	19005
Number of students (person)	3412	3285	3082
Number of faculty (person)	178	178	178
Unit consumption of water (m ³ / person/year)	7.87	7.24	5.83
Advanced value of provincial quota (m ³ /person/year)	11	11	11

The daily water consumption trend of typical buildings is shown in Figure 3. It can be seen that the daily water consumption trend of campus buildings in 2021 is slightly greater than that in 2022. From the analysis of the relationship between school time and water consumption, the water consumption during winter vacation and legal holidays will be significantly reduced. The water consumption of some buildings (teaching buildings and canteens) also shows the characteristics of weekly variation. Generally, the water consumption from Monday to Friday is large, and the water consumption will be reduced on weekends.

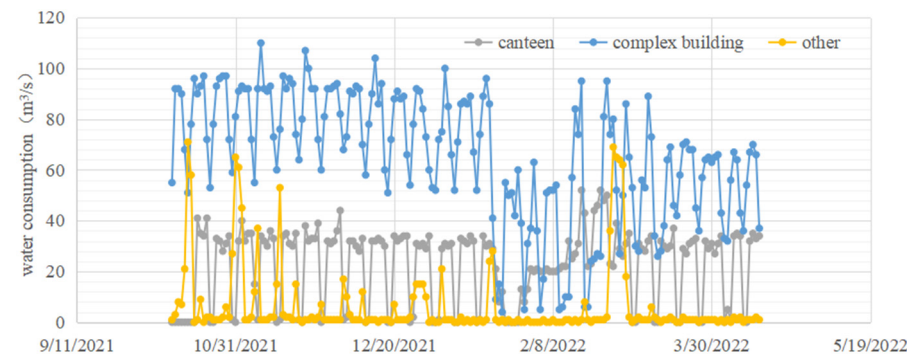


Fig. 3. Daily water consumption

5 Analysis of Water Saving Potential

The construction of water-saving schools focuses on reducing per capita water consumption, improving the popularity of water-saving appliances and reducing the leakage rate of pipe network, strengthening water-saving publicity and education, improving students' water-saving awareness and popularizing water-saving knowledge.

5.1 Fine Management of Water Saving

The installation of metering facilities and water-saving devices is shown in Figure 4. By improving the allocation rate of water metering facilities, improving the popularity of water-saving appliances and strengthening the test and analysis of water balance, we can tap the potential of water saving. By analyzing the water balance relationship and

water consumption level, the reconstruction of pipe and appliances can be carried out to further reduce the leakage rate. The school has updated more than 100 quick opening water valves and invested more than 50000 yuan to install the induction flushing system. Water saving should be carried out throughout all links and the whole process of water intake management. The requirements of "three Simultaneities" for water-saving facilities shall be strictly implemented for new construction, reconstruction and expansion projects. During the establishment of water-saving carrier, information-based means were used to carry out water intake management, such as an online monitoring system, which can reduce the amount of leakage by more than 70%.



Fig. 4. Installation of metering facilities and water-saving appliances

5.2 Unconventional Water Utilization

The installation of water utilization facilities is shown in Figure 5. By strengthening the utilization of unconventional water (mainly rainwater), reduce the utilization of conventional water sources and improve water efficiency. As a water rich area in the south, Zhejiang Province has abundant rainfall and great potential for rainwater utilization. However, due to the limitations of site conditions, there is less utilization of unconventional water such as rainwater. The main utilization mode is to design and use devices for greening sprinkler irrigation. The school has established a roof rainwater collection system with two $0.5\text{m}\times 0.5\text{m}\times 1.2\text{m}$ tank.

For example, according to the calculation of greening water quota in the standard of water quota of Zhejiang Province, if unconventional water is used, greening can save water by 1.5l/d. If unconventional water is applied to other aspects such as environmental sanitation management and urban park management, the water-saving potential will be greater.



Fig. 5. Installation of unconventional water utilization facilities

5.3 Create a Good Water-Saving Atmosphere

By strengthening the publicity and education of water conservation in schools, the publicity, education and practical activities of water conservation can be included in the annual work plan and evaluation. There are various forms of publicity and education, such as training, lectures, observation, etc.. We should not only carry out activities in the water-saving publicity week, but also standardize the water-saving publicity, integrate the water-saving publicity into students' classroom education and food culture, and truly deepen the awareness of water-saving. By carrying out various water-saving

publicity activities, such as posting water-saving publicity slogans and posters, and carrying out random water-saving questionnaire survey, the school has made the majority of teachers and students understand the importance and urgency of saving water resources, and initially formed the concept of "saving water starts with me".

6 Conclusions

The shortage of water resources has become an important restrictive factor for China's economic development and social progress for a long time. Water conservation is a strategic measure in China. As main water consumers, schools should play an important role in the process of creating a water-saving society and a water-saving city.

Through the investigation on the current situation of water resources utilization in a university in Zhejiang Province, the current unit consumption of water in the University in recent three years is less than the advanced value, and the water saving situation is good. However, the water-saving potential of colleges and universities can still be further improved. For example, monitoring the leakage of pipe network by means of informatization can reduce the leakage by more than 70%. For example, 1.5l/d of water can be saved by using rainwater per square meter of green area. In addition, we can also promote water conservation, protect water resources and create a new situation of water conservation in Colleges and universities through organization construction, system construction, technical measures and publicity and education.

Acknowledgments

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