Twin Tanks for Fresh and Flush Water Supply System in Hong Kong Housing Authority Public Rental Housing Estates

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Summary

Water supply interruption during tank cleansing often causes inconvenience to residents. A solution is now in place with the introduction of the innovative “twin tanks for fresh and flush water supply system” to all new public rental housing projects since 2008. Originated by the Hong Kong Housing Authority, the system not only allows continuous water supply to residents during regular tank cleansing, but also facilitates maintainability and helps to conserve the environment by saving water. The first two public rental housing estates benefiting from the new system completed in 2009 are Yau Lai Estate in Yau Tong and at Shek Mun Estate in Sha Tin.

According to the Hong Kong Waterworks Standard Requirements Clause 4.9 and the Hong Kong Housing Authority’s current practice, all fresh and flush water tanks need to be thoroughly cleaned at least once every three and six months respectively. Normally, water supply will be suspended for about four hours for the cleansing process. Residents may need to store fresh water for temporary use or use fresh water to flush toilets during those periods. There is also considerable wastage when water remained in the tanks has to be drained away for tank cleansing.

Our twin tank system is first of its kind putting in use in high-rise residential development, original and practicable. The design divides each water tank into two compartments and adopts an “alternately operating” approach. When one of the tanks is shut down for cleansing, the other will remain in operation thus ensuring continual water supply to residents.

A step by step cleansing procedure is also established for the new system. It passed the test when Shek Mun Estate has its first tank cleansing carried out in September 2009 and the residents were satisfied with the operation. With the completion of more new estates, it is estimated that about 75,000 households will benefit from the system in the coming five years, and about 2.8M litre of water can be saved every year.

On top of the twin tank design, HD also adopt modified water tank discharge pipe-works, enhanced water tank construction and higher grade waterproof concrete for both water tank and roof floor construction to enhance durability.

The new system achieves a win-win situation for all. Residents’ quality of living can be improved as they no longer suffer from interruption of water supply. To the Hong Kong Housing Authority, the system is cost effective as roof structures become more durable and the service life of buildings

extended. Society as a whole will also benefit as the system is conducive to environmental protection and sustainable development.

Keywords: Twin Tanks, Uninterrupted Water Supply, Water Saving, Reduce Maintenance & Repair

1. Background and Objectives

The green building research study on Twin Tank System brings benefits to the environment by saving water and convenience to public rental housing tenants by providing uninterrupted water supply during cleansing of water tanks in domestic blocks. The system so derived meets the Hong Kong Housing Authority's corporate objectives and is founded on our core values of 4C's: namely Caring, Customer focused, Creative and Committed. It meets present social, economic and environmental needs but NOT at the expense of future generations. (Fig. 1)

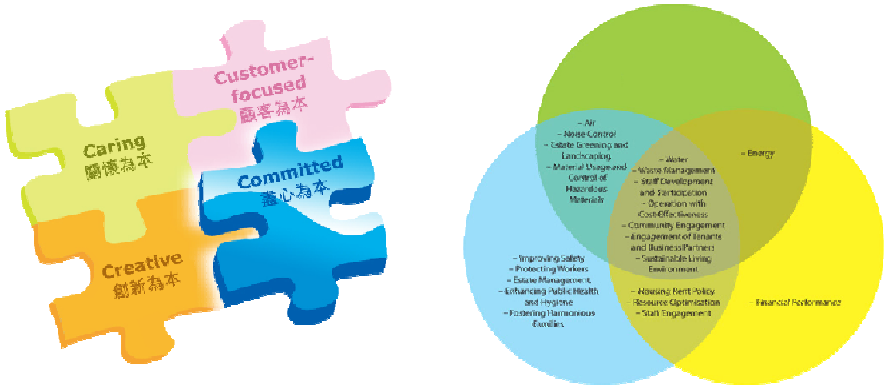


Fig. 1 4C's: Caring, Customer focused, Creative and Committed; Social, Economic and Environmental needs

According to the requirements of the Water Authority and the Hong Kong Housing Authority's water tank cleansing schedule, our maintenance team shall carry out regular cleansing of fresh and flush water tanks in every three and six months respectively. Normally, water supply will be suspended for about four hours when the tanks are cleaned. Whilst these cleansing operations assure water quality and hygiene for healthy living, interruption of water supply is inevitable and often causes inconvenience to tenants. During the time of cleaning of fresh water tanks, tenants will have to store water before stoppage. They would also need drain away the first flow of fresh water to wash away muddy water after resumption of water supply. In case of flush water tank cleansing, more water will be wasted as tenants would use fresh water for flushing during the interruption of flush water supply. (Fig. 2)

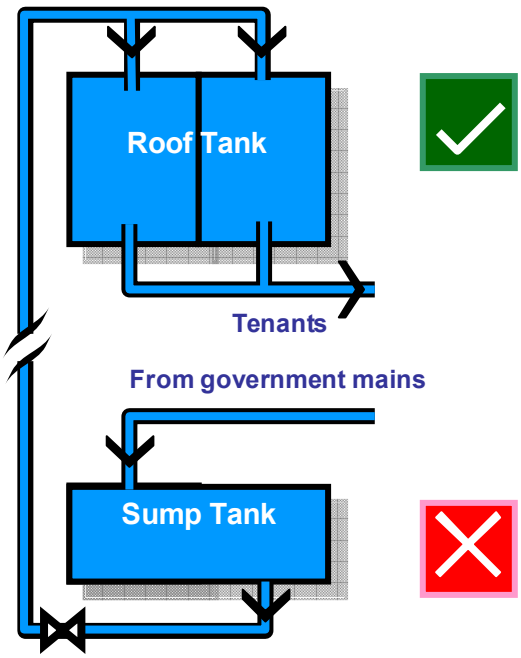
Fig. 2 Suspension of Water Supply

It is also very common and considerable wastage that large amount of water will be discharged from the wash out of water tanks before cleansing, free flowing across the roof top to the drain point, and leading to water ponding and possible damages to the roof slab especially in the case where sea water is used for flushing. (Fig. 3) In the last Comprehensive Structural Investigation Programme in 2005 conducted for the occupied blocks by the Hong Kong Housing Authority, the reinforced concrete structure of a number of roof tops and water tanks have been badly deteriorated by chloride attack and around 30% requires immediate replacement or extensive repairs.

Fig. 3 Water Ponding and Damages to Roof Structure

2. Concept

With the clear objectives on “Saving water”, “Providing uninterrupted water supply” and “Reducing maintenance and repairs”, the Hong Kong Housing Authority initiated the concept of Twin Tank System in January 2007. We started off by examining both fresh and flush water tanks at the roof and ground level (sump tank) in form of twin tanks. It was estimated that the full capacity of the roof tank only would be sufficient to maintain uninterrupted water supply to tenants during the cleansing works of small size sump tank at ground level. Therefore, we considered not necessary to apply the twin tank concept to the ground level sump tank and focus on its adoption in roof tank only. (Fig. 4)



Adopt Twin Tank System for Roof Tank:

- Maintain water supply from one of twin tanks to tenants at all floors during cleansing of another one of twin tanks

Also adopt associated enhancements:-

- Direct discharge of waste water to waste stack
- Use coated reinforcement and high grade concrete

NOT Adopt Twin Tank System for Sump Tank:

- Smaller size (1/3 size of roof tank)
- Full capacity of roof tank can provide adequate water supply after pump stoppage for 2 hours cleansing

Fig. 4 Assessment to Water Tanks at Roof and Sump Tank at G/F in form of Twin Tanks

2.1 Twin Tank System

To materialize the twin tank concept into the physical design, the system requires a separation wall between the two tanks with additional supply pipeworks and fittings (Fig. 5).

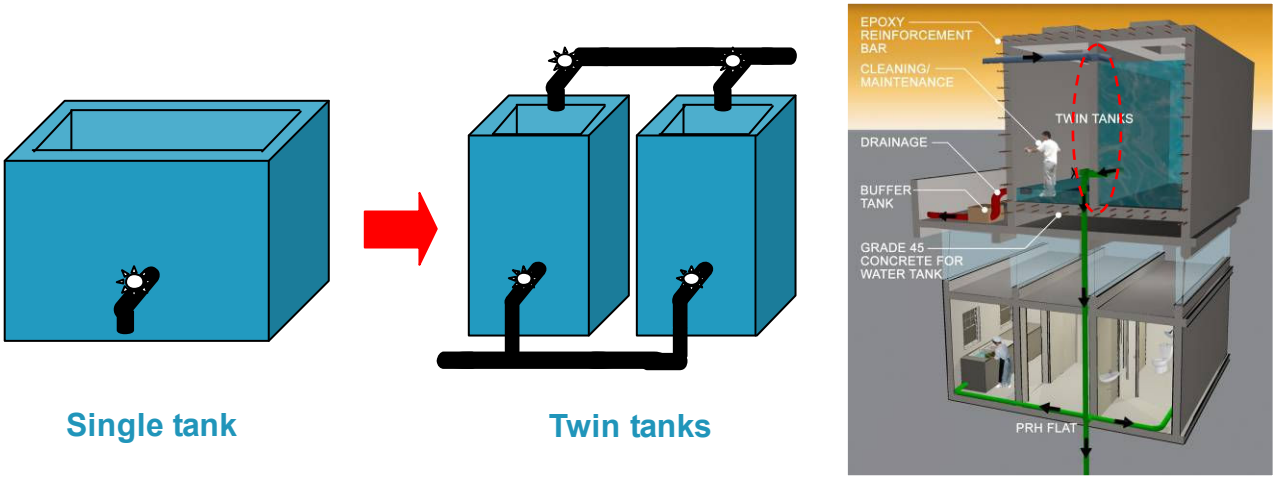


Fig. 5 Twin Tanks Concept

The Hong Kong Housing Authority started working out a feasible and workable cleansing procedure to maintain the water supply. The following figures show diagrammatically the sequence in steps (Fig 6):-

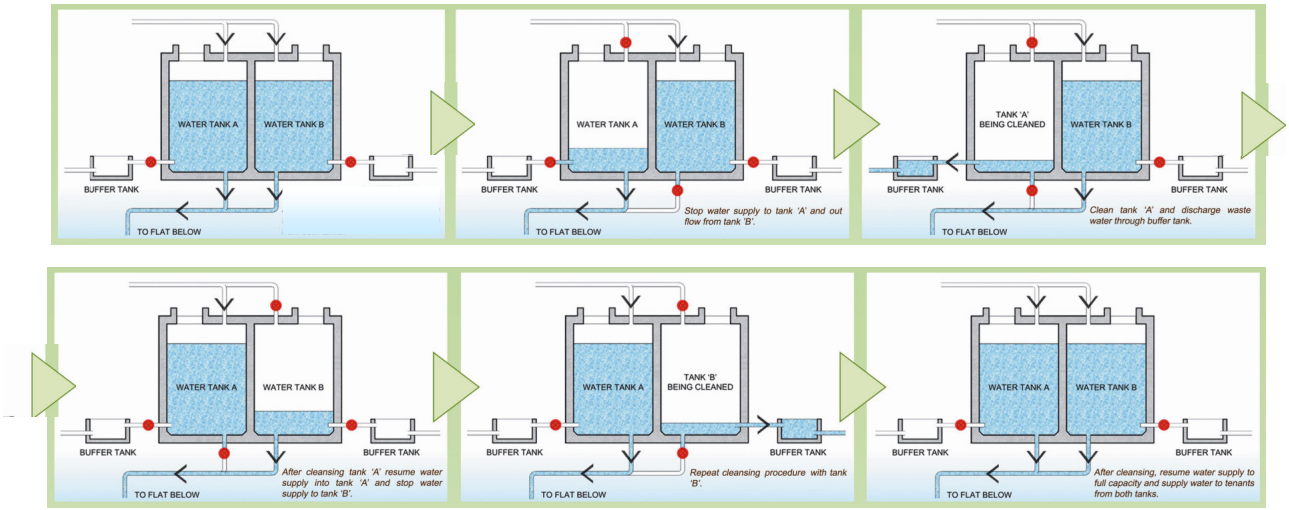


Fig. 6 Cleansing Procedure

2.2 Statutory Compliance

With the additional water supply pipeworks and fittings, the twin tank system basically contravenes the original Hong Kong Waterworks Standard Requirement Clause 4.1. which has no allowance for twin tanks, such as

- Only allow “one” ball valve and “one” fullway gate valve; and
- Only “one” automatic control switch and “without” any stop valve in the case of a pumped supply.

Upon consultation with the Water Supplies Department, they readily accept this novel arrangement, and in response promulgated under their WSD Circular Letter No. 4/2007 - Amendments to “Hong

Kong Water Works Standard Requirements" Clause 4.1 in October 2007 - allowing each tank fitted with an automatic control switch and a stop valve for temporary isolation purpose in the case of a pumped supply to the twin tanks (Fig. 7). An additional pressure switch at the water pipe rise at ground level pump room is also required to shut off the pump and actuate an alarm under no-flow condition. This measure is to protect the pump from being damaged and lead to long period of water supply interruption when both stop valves of the twin tanks are accidentally shut off.

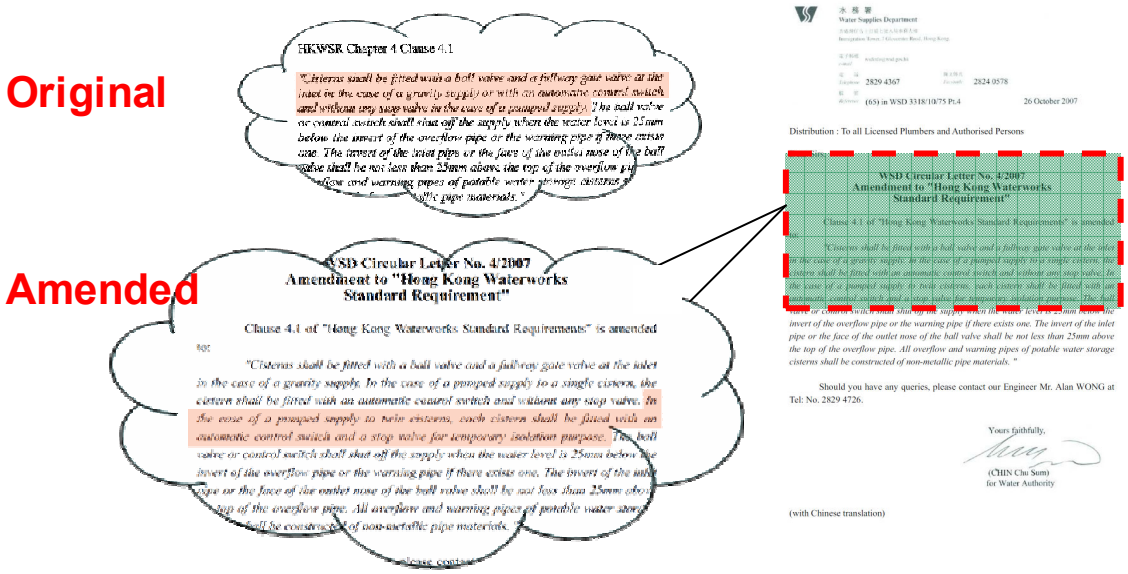


Fig. 7 Amendment to "Hong Kong Water Works Standard Requirements" Clause 4.1

2.3 Implementation and Benefits

The new system has been fully incorporated in all the Hong Kong Housing Authority's new Public Rental Housing projects at design stage since May 2008. Cleansing workers are trained to follow the cleansing procedure straightly (Fig 8).

Fig. 8 Workers Training

Shek Mun Estate at Shatin, Hong Kong completed in May 2009 was the first estate using the system. Other recently completed public rental housing projects using the system include Yau Lai Estate, Chai Wan Estate, Choi Tak Estate and Mei Tung Estate (Fig. 9). The system can save up to **2.8 million litres** of water per year and can bring convenience to 75000 flats in the next 5 years.

Fig. 9 Shek Mun Estate at Shatin; and Yau Lai Estate at Yau Tong

2.4 Associated Enhancements

Other associated enhancements include direct discharge of waste water to water stack and enhancing structure of roof slab and roof tanks are introduced for better durability and sustainability of the structure. We estimate that there will be cost saving of $2 million for each domestic block for replacement of water tanks in 30 to 40 years. As expected, “Zero” adverse comment has been received from the tenants in the estates using the system.

2.4.1 Direct discharge of waste water (Fig. 10)

In discharging the residual and waste water, the Hong Kong Housing Authority adds new pipings to allow direct discharge via buffer tanks or hoppers into the waste stacks instead of free pouring across roof slab.

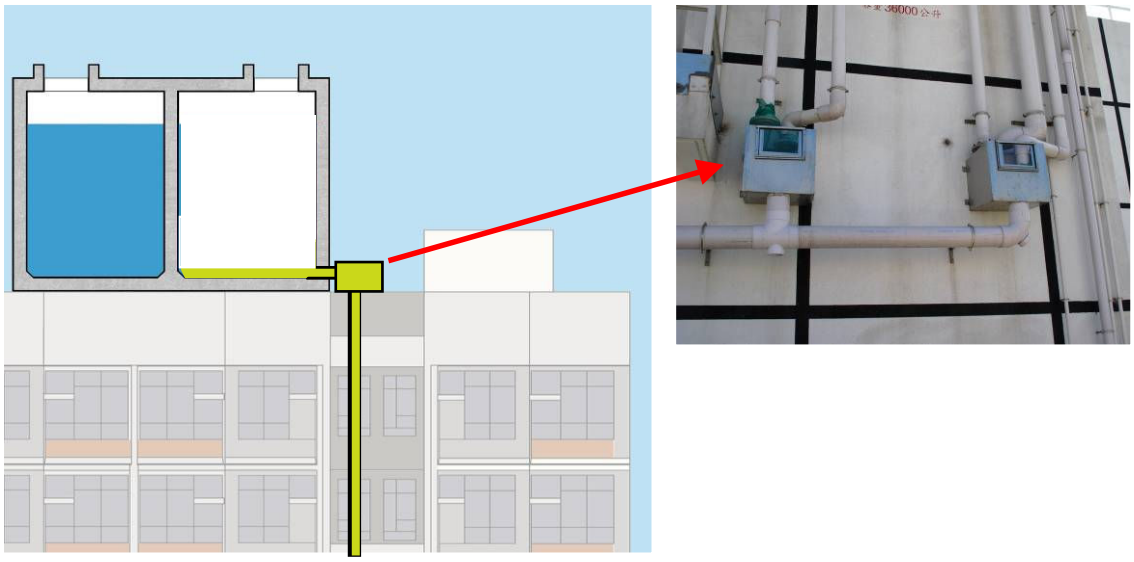


Fig. 10 Direct discharge of waste water with Hoppers or Break Tanks

2.4.2 Enhancing durability of structure (Fig. 11).

Epoxy coated reinforcement and higher grade concrete are introduced for use in the roof slab and the roof tanks. Twin water tanks are to be constructed with Grade 45 waterproof concrete and reinforced with epoxy coated re-bars and main roof slabs are to be constructed with Grade 45 concrete designed to satisfy the moderate exposure condition in CoP 2004.

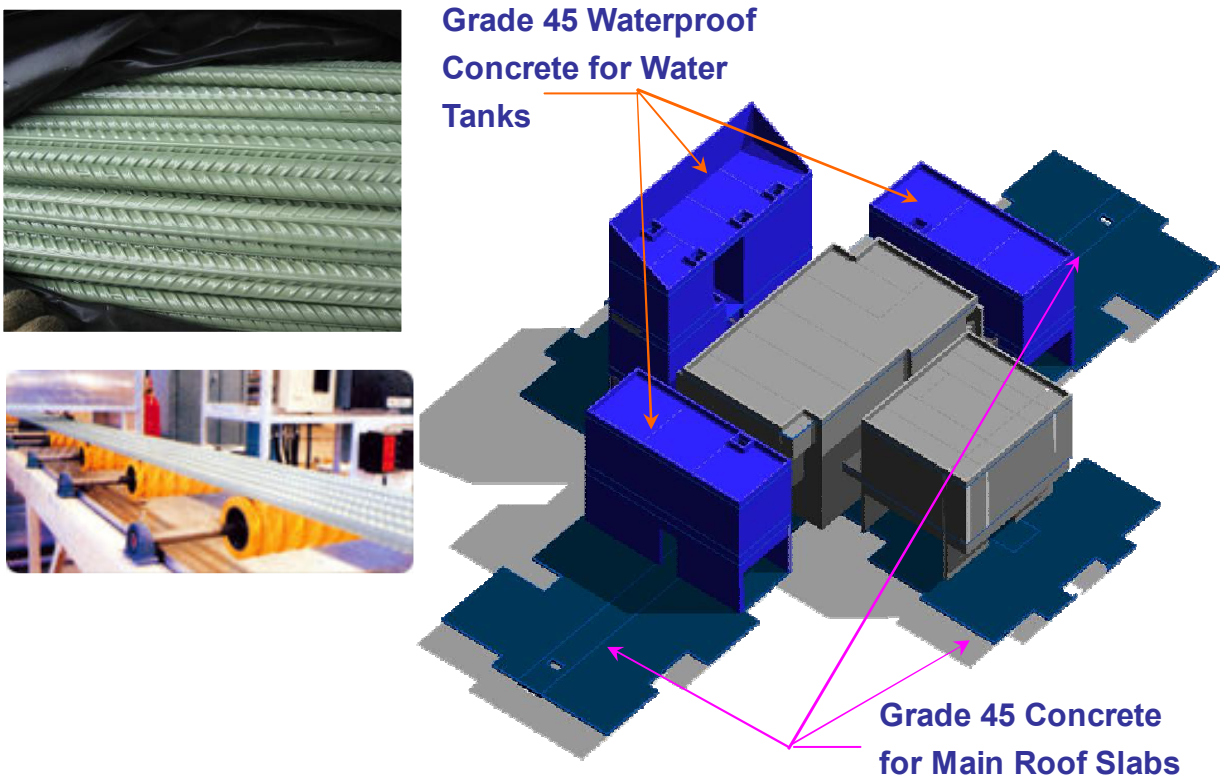


Fig. 11 Epoxy Coated Reinforcement and Higher Grade Concrete to Roof Slab and Water Tanks

3. Recognition & Commendation

The design team of the twin water tank system has been granted a Special Citation (Cost effectiveness) Award under the category of General Public Service (Team) of the Civil Service Outstanding Service Award Scheme 2009. In 2010, the system was awarded the Finalist in the Green Building Award 2010 under the Hong Kong Green Building Council (Fig. 12)

Fig. 12 Civil Service Outstanding Service Award Scheme 2009 and Green Building Award 2010

4. Conclusion and Way Forward

The new water supply system achieves a win-win situation for all. Residents' quality of living can be improved as they no longer suffer from water interruption during tank cleansing. To the Hong Kong Housing Authority, the system is cost effective as roof structures become more durable and the life

of buildings is extended. Society as a whole will also benefit as the system is conducive to environmental protection and sustainable development.

In our core values of 4C's, the Hong Kong Housing Authority cares for the tenant's convenience and environmental impact; focuses on customer's need for more reliable water supply; creates an original system for domestic blocks in Hong Kong; and commits to face and resolve hurdles in statutory requirements. As a responsible public sector developer, the Hong Kong Housing Authority has displayed an innovative system that meets the 3 dimensions of sustainability, economics, environmental and social sustainability. For the society, we set good example in water conservation and raise the public awareness in saving water. For the global gain, we conserve a natural resource: water which is becoming scarce. The Hong Kong Housing Authority will continue to work closely with other government departments, non-government organizations, academic, and industry at large to promote the design and other water saving initiatives in the public and private sectors for better conservation of our water resources.