South Korea

Rainwater Harvest System – Star City, Seoul

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Photo: POSCO

Aerial image of Star City Seoul, 4 appartment towers with 1,310 appartments. Completion in April 2007 after a four year construction period.

The Rainwater Research Center (RRC) at Seoul National University, and Prof. Mooyoung Han, its director, played an integral role in conceiving and implementing the rainwater harvest system at Star City, a major real estate development project with more than 1,300 apartment units in Gwangjin-gu, a district in eastern section of Seoul. The RRC role in the project began inconspicuously, five years prior to the Star City project, when a national weekly newspaper and an internet newspaper carried Prof. Han's bi-weekly articles on rainwater harvest. In time, RRC designed a rainwater harvesting system to be installed at Star City. Other parties participating in the project included KonKuk Asset Management Corporation, the land owner and developer; Gwangjin-gu, the local government, which played a pivotal role, together with RRC, in conceiving and implementing the system at Star City; Seoul Metropolitan Government Urban Planning Board, a city authority; MyungSun Engineering Co., the designer of the entire real estate development project; and Posco Engineering and Construction Co., Ltd., the general contractor.

The basic design idea for the Star City rainwater harvest system was to collect up to the first 100 mm of rainwater that falls on the complex and to use the collected rainwater for gardening and public toilets. The entire fourth floor below the ground in Building B at Star City is used as water storage area. All together it can store 3,000 cubic meters of water in three separate tanks with a total floor area of 1,500 square meters. The capacity of the tank is 1,000 cubic meters each. The first two tanks are used to collect rainwater from the rooftop and the ground, respectively. The water collected from the rooftop and the ground mitigates the danger of a flood in the area during the monsoon season. Collected rainwater is used for the purpose of water con-

Photo: POSCO

Site plan of the four towers, in total 6.25 hectares in Seoul's City Centre.

servation. Especially, most of garden irrigated water is infiltrated into the ground and returns to the tank for multiple use. The third tank is to store tap water in case of emergency. Fresh tap water is maintained by decanting the half of old water to the rainwater tank and refilling on a regular basis. Based on the half year operation of the system, we expect the water conservation to be approximately 40,000 cubic meters per year, which is about 67% of the annual amount of rainfall over the Star City complex. Considering the average cost of supplying one cubic meter of tap water in Korea is about seven U.S. dollars, the saving is significant to the city, while the residents will save about US$ 80,000 per year in reduced payment for water. This cost saving will increase as the price of water increases in the future along the rising cost of energy.

Several innovative concepts have been applied in implementing the rainwater harvesting system at Star City. The first is the concept of a multi-purpose system; the system at Star City serves the purpose of flood mitigation, water conservation, and emergency preparation. The second is the concept of proactive management of flooding; the Star City system has a remote control system for monitoring and controlling the tank water level. The three different tanks also store water separately according to water quality. The risk of flood can be controlled pro-actively with the remote control system by emptying or filling the tanks appropriately. The third innovative concept applied in this project was the city government's incentive program for the developer, which will be explained further later in this description.

The complete dependence of city water supply and drainage on a centralized system has a number of vulnerabilities in the age of steady climate change and increasing urbanization; there is also the issue of aging infra structure and increasing energy cost. These nature-borne and man-made risks can be reduced with supplementation of decentralized water management system. The supplementary role of decentralized water management system can be illustrated with Local Rainwater Utilization Ratio (LRUR), which indicates the amount of rainwater utilization in terms of the total amount of annual rainfall in a given area. The ratio at the Star City complex in 2007 is estimated to be 67% with 40,000? of rainwater utilization. The ratio is zero percent at thousands of similar building complexes in Korea and throughout the world. It should be noted that this ratio of 67% at Star City is much higher than the Korea national ratio of 26%. The decentralized system can radically improve LRUR, and this is a solution that the water engineering profession can use in the future to supplement the current centralized system and reduce the risks associated with it.

The construction cost for the rainwater harvest system was approximately US$ 450,000, about one third of the average real estate price of an apartment unit at Star City today. Considering the water saving during the operation, the cost will be recovered in less than eight years. The residents also benefit from the system in that they pay less for the building maintenance fee to enjoy one of the largest landscaped gardens in Korea. They also benefit from reduced risk of flooding and heat island. At a broader level, because the decentralized system harvests rainwater on site, before it becomes dirty, it reduces the energy required — and therefore the carbon dioxide production and the long-term social cost — for water treatment and transportation.

The significance of the rainwater harvest project at Star City is that we used a relatively simple technology in a large development project with complex network of stakeholders. The Star City project has demonstrated that rainwater harvest can be practiced in both rural and urban environments, on both small and large scales, with concrete and immediate benefits to the stakeholders and enormous potential social consequences in the long term. Upon evaluation of the Star City project, the city government has already passed a city-wide ordinance to promote more installation of the rainwater harvesting system in development projects.

Preference for the familiar, i.e. the traditional centralized system, fear of being the first case, and additional private expenditure were some of the biggest challenges in installing a rainwater harvest system at Star City. The leadership of the local government played a pivotal role in overcoming many of these obstacles. For example, the local government offered an incentive to the developer to alleviate fear of

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Capital:	**Seoul**
Area:	**99,392 km²**
Inhabitants: (February 2007)	**49,024,737**
Density of population:	**489 inhabitants per km²**

Seoul

Area:	**608 km²**
Inhabitants: (2005)	**10,280,000**
Density of population:	**17,000 inhabitants per km²**

Source: http://de.wikipedia.org/wiki:
Thorsten Schütze, fbr-wasserspiegel 1/06, page 16

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any economic disadvantages. The incentive was that the developer would be permitted to construct three percent more floor space above what would normally be allowed. Considering the real estate prices in Seoul, this was a significant incentive. Now, the ownership of Star City has been transferred from the asset management company to the Star City Residents Council. The regulatory body at SMG was initially reluctant to approve the project, the first of its kind. SNU RRC answered questions on scientific and technical issues for the optimal design of the system. The most common misconception was that rainwater is contaminated with harmful substances from the atmosphere and that it cannot be used without treatment. This misconception comes from misunderstanding of basic water circulation system.

The construction of the rainwater harvest system itself is not very complicated, and it was completed on time and within the planned budget. Apart from the benefit of paying less for maintenance, the residents are also enjoying the prospects of increased real estate value that comes from favorable publicity of the rainwater harvest system at their residential complex.

Executive Summary

The safety risk for urban water management has been increasing due to climate change and urbanization all over the world. In order to overcome these problems, there is a real need for multi-purpose, safe and sustainable decentralized solutions, such as a rainwater harvesting (RWH) system, along with centralized water supply system. But, this is not fully implemented due to the complexity of persuading the interested parties, preference for the familiar, i.e. the traditional centralized system, and misconception of rainwater quality.

The RWH system at Star city, a large-scale residential and commercial complex in Seoul, was introduced for urban water management. Several innovative concepts such as a multi-purpose system, proactive management of flooding, and the city government's incentive program for the developer have been applied in implementing the RWH system at Star City.

Although the project is small, the impact to the world is enormous because of following inherent advantages as follows.

- **Reducing risk of local flooding and increasing Eco efficiency by water conservation**
- **Climate change adaptation implementation as a supplementary system to existing water infrastructure to cope with extreme rainfall events such as flooding and drought.**
- **A peaceful water management solution where all stakeholders win.**