Green roof waterproofing solutions in Hong Kong

As environmental sustainability becomes more of a concern globally, green roofing is proving increasingly popular in many countries due to its ecological, financial and aesthetic benefits. In essence, a green roof is a roof of a building or podium deck that is partially or completely covered with vegetation, such as grass, wild flowers and herbs, planted over a waterproofing membrane. It often includes additional layers such as drainage and irrigation systems.

Green roofs can offer savings on heating and cooling, provide effective insulation, reduce energy consumption, create a habitat for wildlife, help lower urban air temperatures and reduce Urban Heat Island (UHI) effect, whereby little vegetation or evaporation causes metropolitan areas to get warmer.

Germany was instrumental in introducing the concept of green roofs in the 1960's and they have become common in many other countries, including the United States. In the UK, green roofing has been actively promoted, but uptake has been relatively slow; however, a number of cities such as London and Sheffield have developed policies to encourage their use. Further afield in continents such as Asia, where environmental concerns include stormwater runoff overflow and poor air quality, financial incentive programmes have long been in operation to promote green roofing. In Japan, all new private buildings larger than 1000m2 and public buildings larger than 250m^2 must provide 20% of green roofing or an annual penalty is levied.

One area where Flexcrete has found that green roofing is becoming more popular is Hong Kong, particularly in the water industry, as many of the water treatment facilities are located in high-rise urban areas and service utilities are often cluttered on the rooftops of tall buildings. There are also many Pumping Stations and Storage Tanks located in rural catchment areas, whereby water is taken from streams running down the hills. In these cases, green roofs blend in with the natural environment and become much less of an eyesore.

Urban Heat Island (UHI) effect is a significant problem in Hong Kong, in that the high temperatures in the city centre can create adverse health effects, additional demand on indoor air conditioning and a reduction in air quality by creating smog. Combatting UHI effect is a major reason for creating a green roof in Hong Kong, as traditional building materials soak up the sun's radiation and re-emit it as heat, making cities at least 4 degrees Celsius (7°F) hotter than surrounding areas.

Elevated temperatures also lead to the sea warming up, resulting in increased water evaporation and torrential downpours of rain. These flash floods are a major problem in concrete urban areas, as there is nowhere for the surface water to drain, other than drainage systems that cannot often cope with the sudden deluge of heavy rain. With green roofs, the roof is able to absorb the majority of the water, with the runoff taking days rather than minutes, thus relieving pressure on the drainage systems. Studies show that vegetated roofs are able to retain over 80% of rainfall compared to 27% with standard roof coverings. Green roofs are also energy efficient and air conditioning costs can be reduced by as much as 15% when they are installed.

Hong Kong's Water Supplies Department (WSD) operates many Seafront Pumping Stations that supply water to Hong Kong residents. These include Shatin Seafront Pumping Station in Shatin New Town, one of the fastest growing urban areas in Hong Kong. In the early 1970's, the area was home to around 30,000 people, a number which has since increased to 650,000, placing increasing demands on the water and wastewater infrastructure. Hong Kong uses more water per capita than most first world cities and the water supply is only guaranteed to 2014; up to 80% of Hong Kong's water supply is from Guangdong, China, and if supply from Guangdong was ever disrupted, Hong Kong could potentially have to revert back to the water rationing days before it started importing water from the mainland back in the 1960's.

WSD also operates the Tai Po Water Treatment Works (WTW) which supplies fresh water to a significant part of Kowloon, as well as the Central and Western districts on the island of Hong Kong. Shatin Seafront Pumping Station and Tai Po Pumping Station, which forms part of the wider Tai Po WTW, both required remedial work to replace previously failed waterproofing systems on the rooftops of the Pumping Stations. Green roofing areas have been installed at both Pumping Stations to help achieve environmental sustainability by reducing the rate and volume of stormwater runoff and minimising cooling loads on

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the underlying buildings in summer and heat loss in winter.

Cemprotec Elastic, one of Flexcrete's flexible, cementitious modified, waterborne coatings, was specified to waterproof the roofs at both Shatin Seafront and Tai Po Pumping Stations before vegetation was planted. The coating maintains its elastomeric properties even when under permanent immersion and it is independently tested for root resistance, a vital consideration in green roof design. It is also CE marked in accordance with BS EN 1504 and is WRAS (Water Regulations Advisory Scheme) approved for use in contact with potable water.

Applied by spray and brush, Cemprotec Elastic cures to protect the substrate from water penetration and carbon dioxide diffusion and also accommodates movement in cracks. For these projects, Cemprotec Elastic formed part of the revolutionary Midori-chan green roofing system which is designed to maximise vegetation growth and recycle waste, whilst dramatically minimising water usage. Developed by the Kawada Group in Japan, Midori-chan is based upon a system in which rainwater is effectively recycled, stored and supplied to vegetation. The system mimics and improves upon the system of water supply and evaporation that occurs naturally in the earth's surface.

Midori-chan uses 90% less water than other systems. Rainwater is filtered through the soil and regenerated charcoal, enabling retention of clean water in a water storage unit whilst excess water overflows into a rooftop drainage system. During fine weather, the soil begins to dry from the surface. Once the regenerated charcoal beneath the soil has dried, it then absorbs the water vapour from the airspace above the water storage unit and feeds to the roots above, ensuring that the surface remains dry. Additional rainwater restarts the natural circulation system.

Flexcrete's waterproofing system was backed by a 20-year warranty and is designed to remain low maintenance, conserve water and withstand the harsh climatic conditions typified by high temperatures, strong winds, high salt content and considerable shading. The work was carried out for Kawada Industries, Inc. by Flexcrete's Hong Kong based distributor, Technicient Engineering Company and Green-Works Asia Limited.

Cemprotec Elastic is prepackaged, only requiring mixing on-site and it achieves an even finish with no sagging, even in vertical situations. As a water-based product, it is free from hazardous solvents and non-toxic when cured, making it suitable for use in confined spaces. It can be reinforced with Cemprotec Geo80, a thermally bonded, non-woven geotextile, on cracked substrates or with Cemprotec 2000-S, a flexible, WRAS approved, waterproof sealing tape, to treat formed joints and dominant cracks.

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Some of the other technical benefits of green roofing include the extended lifespan of the roof. In hot climates such as Hong Kong, temperature fluctuation is the prime cause of the disintegration, cracking and splitting of roofing materials. As green roofs are covered with vegetation, the roof surface can be as much as 30°C cooler than nearby exposed paved surfaces, hence water departments and building owners can benefit from significant roof cost savings over a period of time.

At Tai Po Pumping Station, the parapet walls were also coated with Roofdex HB, a waterborne, high build, elastomeric, cold fluid applied liquid coating manufactured by Flexcrete Technologies. Roofdex HB is ideal for providing weatherproof protection to roofs and walls in hot, humid climates due to its ability to reflect sunlight and withstand extreme temperature ranges from -50°C to +80°C. Roofdex HB maintains a wet edge even in direct sunlight, thus making it suitable for use all year round. Applied in solar reflective white at Tai Po to reduce heat build-up and energy consumption, tests have shown that Roofdex HB has outstanding resistance to weathering. Even after 20,000 hours QUV-B testing, Roofdex HB has shown no signs of deterioration.

When a liquid applied membrane has failed on an inverted roof, it normally takes at least two weeks to sufficiently dry out before most fluid applied systems can be applied over the top, effectively leaving the building with no waterproofing and prone to flooding and extensive damage. With both Cemprotec Elastic and Roofdex HB however, the coating can be applied directly to the damp substrate immediately after removal of the defective membrane, thus eliminating threats of water penetration and enabling projects to be completed much quicker.

Both projects at Shatin Seafront Pumping Station and Tai Po Pumping Station have provided Hong Kong's WSD with an effective waterproofing system as an integral part of the green roof, with the ability to provide a multitude of benefits including reducing UHI effect, retaining stormwater and minimising energy consumption.

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