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Potential world first in waste stream upcycling at the V&A Waterfront

A new project broke ground at the Portswood District of the V&A Waterfront last year. The project upcycles a significant stream of plastic waste using sustainable methods. The project in question is the Ridge Building, a bespoke eco-building currently under construction. It will serve as the regional office of a multinational client, Deloitte.

Mark Noble, Development Director at the V&A Waterfront, says that recycled beverage bottles are being used as 'ecobricks' on site. Made from polyethylene terephthalate (PET) plastic bottles, these include 'Coke' 2 litre bottles. The ecobricks will be used as void formers in the concrete slabs in the central toilet areas on each floor of The Ridge.

The bottles are filled to constant density with waste plastics. This waste includes chip packets, candy wrappings, shopping bags and waste generated on site. The filling gets done by community volunteers from Cape Town's suburbs and quality control is undertaken on site by GVK. The checked bottles then get used as void-formers at the Ridge.

"Often, builders incorporate void-forming materials into concrete slabs. These are of a much lower weight than concrete. They are sometimes made of expanded polystyrene (EPS). Under normal loads, these voids do not undermine the structural strength of the slab. But they offer many other benefits, which is why we use them.

"The recycled PET bottles are called ecobricks. To the best of our knowledge, the Ridge is the first large commercial building in the world to do this," says Noble.

Background - how the concept works

From a structural perspective forces run along the outside of the structural member of a building. This useful characteristic has allowed, for example, the safe usage of bricks with holes in the middle.

So, the core of a concrete structural element plays little role in imparting strength, but a hollow or near-hollow core can remove a tremendous amount of weight from the building. Consequently, less concrete and structural steel may be used to support the additional weight of the building than would be the case without the void-formers.

Void formers are more than a significant opportunity to lower the material cost of the building. Void formers also dematerialise the construction. In green building technology, this reduces the embodied carbon and energy 'footprint', meaning lowering its environmental impact. Less usage of materials such as concrete and steel also reduces building material waste recovered at the end of the structure's service life.

According to the Green Building Council of South Africa (GBCSA), the construction and operation of buildings globally were found to contribute in excess of one third of all greenhouse gases. Hence any methods that reduce the greenhouse gas contribution of a building are of benefit in the battle against climate change and environmental pollution in general.

From excavation to topping-out, the positive contribution of voided slab weight reduction alone delivers sustainable advantages for property owners, designers and builders.

A commonly used void forming material is EPS, most often formed into shapes or profiles using virgin polymer material. This however does not contribute to environmental benefits and consumes plastics made from fossil fuels.

Sometimes, voided concrete slabs use recycled materials, not only generating far less waste material when scrapped one day, but capturing a waste stream which would otherwise have been sent to landfill, or reprocessed at a cost.

The Ridge - a first among commercial buildings

At the Ridge in the Portwood District of the V&A Waterfront in Cape Town, planners have found an innovative means of removing PET waste from landfill by reusing it inside concrete walling and flooring on site. It also reduces the use of virgin EPS-based void forming shapes.

In addition, thousands of plastic and plastic/foil packets from consumables such as potato chips, chocolate wrappers, cling wrap and shopping bags are used as stuffing inside the PET bottles and removed from waste.

The Ridge project will consume an unbelievable 12 000 ecobricks, each creating a void and displacing on average 2l of concrete.

At an average density of concrete being 2.4 kg/litre for Portland Cement Concrete (PCC), this equates to a displacement of 57 600 kg (or 67 tonnes) of concrete in the absence of any other void forming material being used. The material, cost-saving and environmental benefit of this programme is significant.

What is PET?

PET is best known to us as the ubiquitous non-refundable 2 litre 'Coke' bottle. As a food-grade material it is also used in containers across the food industry. Unfortunately, the plastic is extremely tough and recyclable only by re-use or by mechanically breaking down and chemically reincorporating into PET products such as clothing, bedding and industrial textiles.

The latter is an expensive and energy-consuming option, so many containers just end up on the waste dump.

It has been reckoned that a sizeable proportion of this mountain of waste also gets caught up in stormwater drains and swept out to sea if not adequately sequestered.

The environmental impact of this on the sea of this waste is devastating and humankind is only just waking up to the realities of a so-called '7th continent' at sea, which environmental activist and video producer, Jo Ruxton (formerly of the BBC) describes as an area three times the size of Texas State. (Ref: GBCSA Convention 2019 - 'Ocean of Plastic').

Indeed, scientists explain that the Earth has five ocean 'gyres' which are formed by the normal action of the ocean consist large systems of swirling ocean currents and these vortices are named the North Atlantic Gyre, the South Atlantic Gyre, the North Pacific Gyre, the South Pacific Gyre, and the Indian Ocean Gyre. These gyres also act as aggregation points of the tonnes of plastic and other non-biodegradable waste which is dumped into the sea each minute. The growth and behaviour of these gyres is being tracked by the USA National Oceanic and Atmospheric Administration as well as various scientific and NGO groups globally.

Plastics don't biodegrade, they photodegrade. This means that plastics left for years in fields or water will slowly break into smaller and smaller pieces. Eventually these pieces are so small that they are absorbed by the plants, fish and livestock that humans eat.

Ecobricks

Referred to as a regenerative technology by author and founder of ecobricks.org, Russel Maier of the Global Ecobrick Alliance (GEA), the usage of plastic waste resource stream filled PET bottles is at an early stage globally, but definitely gaining traction. Starting with Central American countries, and the Philippines, westernised nations such as the Netherlands, England, Wales and the USA have followed suit. The South African NGO sector has been very much a part of the mainstream movement.

Ecobricks aim to sequester plastic from various waste streams and regenerate the materials into something that support construction and a reduction in global CO₂. In certain cases, the ecobricks are used as an insulating wall-filling medium for various buildings, including schools. For example in Guatemala, where the first usage of the ecobrick was documented prior to 2009 by the organization Pura Vida Atitlan.

Recently, it was reported that ecobricks were used to build a relief and recycling centre for townspeople whose lives were devastated by the Volcano de Fuego eruption which begun in 2018.

Ecobricks at the V&A Waterfront

Although PET bottles of a specific size are used at the V&A Waterfront site, any size of clear PET plastic bottle may be used. It is important to ensure that both the container and its waste plastic material stuffing are clean and dry to prevent the growth of bacteria.

The waste stuffing is cut or folded into small pieces and then packed in small amounts at a time, rotating and compacting to ensure an even distribution throughout the bottle/brick. According to Ian Dommissie of the Ecobrick Exchange, ecobricks are packed solid enough that they can bear the weight of a person without deforming. This requires a packed density of between 0.33g/ml and 0.7g/ml. The density increases the durability and usability of the brick, as well as removing more of the waste stream source from the environment.

Ecobrick sequestration of plastic also prevents the incineration of plastic and the release of gases and CO₂. It is estimated by the experts that for each 1 kg of ecobricked plastic, 3.1 kg of CO₂ is sequestered.

The ecobricks used at the Ridge were packed by eco-warriors from Cape Town's southern suburbs and collected and coordinated by visionary retail mall staff at Longbeach Mall (www.longbeachmall.co.za).

"We are all very aware of the global issue with waste in our oceans or going to landfill and, as a result, the massive impact this is having on our planet. We met with Candice Mostert from Waste-Ed who first introduced us to the ecobrick when we were hosting our first Eco Art competition in 2018. The organization needed somewhere for the public to drop off the bricks and the mall offered to assist", says Janine Davidson, the marketing manager at Long Beach Mall. <It is worth noting that LBM is owned by Growthpoint>.

They were collected by the V&A Waterfront and were held on site pending their usage in the building. All bottles underwent a quality control process once on site undertaken by the main contractor's team.

Other ecobrick projects at the Waterfront and in the Cape Town, area have been undertaken under the guidance of Ian Dommissie of the Ecobrick Exchange.

According to Dommissie, "A two litre ecobrick can contain 250 small size chip packets or 56 shopping plastic bags. On average they weigh 600grams and minimum weight is 400 grams."

Dommissie and his team recently undertook another ecobrick project, which to some extent has served as an example to the V&A development team as to what can be achieved using the materials. In the back garden of Merchant House, an early stage green building in the Portswood district, a vegetable garden has been laid out for the benefit of building staff and a local feeding organisation.

Planters in the garden are made from ecobricks among other materials. "The V&A Octopus Garden is made up of 1 076 ecobricks in its walls which is the equivalent of 269 000 chip packets. Interestingly, the annual 'on the go snack' packaging market in South Africa is 12 000 tonnes of packaging, which would fill 30 000 000 ecobricks. The Octopus garden has yielded 1704 kilograms of fresh produce" says Dommissie.

"Ecobricks are essentially 'time capsules' which can be re-used by future generations, when new technologies become available and they have finished their current purpose of sequestering tonnes of plastic waste from landfill, saving megatonnes of CO2 pollution", says Mark Noble. "Together with our various other established recycling programmes, which include a substantial quantity of the building waste from the SILO project being re-used, these techniques make a vital contribution to the circular economy. This is what we term 'Our Normal', a bold step into participating in this new economy and the environmental challenges we face", he concludes.