‘BRIDGES ARE A WAY OF CONNECTING OURSELVES, AS ENGINEERS, WITH THE PUBLIC’

For AECOM Global’s Dr Robin Sham, the secret to successful bridge design is looking beyond the calculations to find the humanity in the project

WORDS / HELENA RUSSELL

WHEN HONG KONG’S NEW Cross Bay Link opens later this year, it will signal the completion of one of Dr Robin Sham’s latest high-profile bridge projects. The 1.1km-long link will provide an east-west connection across Tseung Kwan O – otherwise known as Junk Bay – in the New Territories of Hong Kong. Here, an expanding population has created the demand for the new highway, cycle and pedestrian route, and the creation of the steel splayed-arch main span brings a visual identity to what will be an important route, not just for vehicles, but also for leisure.

Sham led the detailed design and construction engineering of the project in his role as director of long-span and specialty bridges at AECOM Global. He speaks proudly of his team’s contribution to speeding up the erection process with offsite fabrication, full-span assembly of the marine viaduct and float-in of the main span, which saved an estimated eight months compared with traditional in-situ construction. “It’s not really about material quantities; the main cost is in the construction programme,” Sham explains. “So, having an intelligent solution for fast-tracking the erection process can save a lot of money.”

A DESIGNER’S MIND

Sham has been based in AECOM’s Hong Kong office for 20 years, but has worked on bridge projects in the region for much longer, initially for consultancy Maunsell. He particularly remembers the challenges of the Kap Shui Mun Bridge (above and left), a double-deck cable-stayed bridge which forms part of the Lantau Link. It opened in 1997 to carry road and rail to Hong Kong’s international airport.

“My boss at the time, Peter Head, called this project ‘Hell on Earth’,” Sham says. “The lower deck is enclosed to protect the traffic from typhoons and to allow road traffic and trains to continue running even in bad weather. The difficulty was in laying the trackwork – very challenging when the cantilevers of the main

The need to provide clearance for large ships complicated the design of the Kap Shui Mun Bridge in Hong Kong

deck are moving all the time." Maunsell led on the design for the bridge, with its 430m-long double deck and 580m of approach viaducts.

Sham's interest in civil engineering, and subsequently bridge design, started at school when he first considered future career options. "Like a lot of engineers, I was pretty good at physics and maths, so I did a bit of fact-finding about what kind of tasks I might enjoy," he explains. "I got fascinated by bridges because they're physical entities and something tangible. I could have gone into other strands of civil engineering, but I felt I wouldn't be able to see the outcome. There's actually an end product in bridge engineering. It's a good way of connecting ourselves, as engineers, with the public."

Like many other bridge engineers, Sham also appreciates the fact that bridges are a metaphor for connection and making links between people and places. "Often, 'bridging the gap' is used as a term to describe some kind of conflict resolution," he reflects.

This appreciation of the human benefits of bridges plays into another of Sham's strongly held convictions: that to be a good bridge designer, you need more than just analytical expertise. "Early on, I realised that in order to get the job done properly – and smoothly – you have to be compassionate and know the humanities, not just the calculations. While some people are purely analytical, others are more balanced; they can do the analytical side of things, but they are also creative and have an interest in the arts, music and so on. That's what I would call a designer. A good designer wasn't made in a day!" he says.

One particular source of inspiration was the Severn Bridge, with its groundbreaking aerodynamic box girder deck. The structure influenced Sham in his formative years and he still admires it as a classic. "People talk about architecture and aesthetics, but really the beauty is in the design and the structure," he says. "That's what attracted me to it, very much so."

THE JOURNEY TO CROSS BAY

After studying for his degree at Birmingham University, Sham did postgraduate research at Imperial College London, gaining his PhD in 1989. "My research was into the application of artificial intelligence in conceptual bridge design," he explains. "While others were looking into the opportunities for AI software, I was more concerned with how the human mind works. I talked to many practising designers, getting a glimpse of the creative process."

Shortly after completing his PhD, Sham joined Maunsell – which subsequently became part of global firm AECOM – and started out working on projects in the UK. One of his

EASY DOES IT
To settle this 200m prefabricated double-arch section into position for Hong Kong's Cross Bay Link, the team used a combination of barge ballasting and the natural movement of the tide

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first was a role on the feasibility study and subsequent site supervision for the Second Severn Crossing, now known as the Prince of Wales Bridge. It was the first project to be built under the newly created design-build-finance-operate procurement model.

But Sham also started to go further afield and came to be known as the one who'd always volunteer for any overseas jobs. "How did I get to work on such projects? The truth is that whenever there was a need for someone to travel – whether that was to the Netherlands, Denmark, Malaysia or anywhere else – I put my hand up every time. Gradually I acquired the experience, and nothing beats it. You can read a book, but how do you do it yourself unless you have experience?"

When he relocated to Maunsell's Hong Kong office in 1999, on what he was told would be a two-year secondment, one of Sham's colleagues questioned what the future held for him. "He asked me if I was worried about my job. Hadn't all the bridges that were needed in Hong Kong already been built?"

But clearly Sham has had the last laugh, having clocked up a two-decade-long whirlwind of limit-pushing spans and major sea-crossings, some of them award-winning. He has even worked on two record-breaking cable-stayed bridges simultaneously.

When Hong Kong's Stonecutters Bridge (above) opened to traffic in 2009, its monopole towers, twin box girder deck and 1,018m-long main span marked it out as a new icon for the bridge sector. AECOM had provided construction engineering support to the contractor. The previous year, the Sutong Bridge had scooped the world record by pushing limits even further, opening its 1,088m-long main span to carry highway traffic over China's Yangtze River. Sham was AECOM's project director leading the construction engineering services on behalf of the main bridge contractor, China Harbour Engineering Co.'s Second Navigational Engineering Bureau. He contributed to a wide range of work on the project, including contractor's alternative design, the development of the construction methodology, construction engineering, erection analysis, geometry control, bridge aerodynamics and wind-tunnel testing.

The monopole towers on the Stonecutters Bridge (left) and the screens protecting pedestrians and cyclists on the Cross Bay Link (below) are pushing boundaries in bridge design

The client for the Mumbai Trans Harbour Bridge (above) is reportedly considering adding Metro lines later

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CONSTRUCTION AND DESIGN IN HARMONY

These days, Sham advocates the close integration of construction with bridge design, a philosophy which he has demonstrated to great effect on the Cross Bay Link. "Instead of having to erect lots of scaffolding in the water, we proposed to build the bridge in pieces elsewhere and assemble them in the same way as you would Lego pieces," he says. As such, the 200m-long splayed arch span was floated into place in a single piece last year, to dramatic effect.

Another innovation was to specify that high-strength steel S690QL was used for the bridge. That delivered a number of benefits, including the ability to make the arch elements more slender, improving the bridge's aesthetics, while also reducing the weight of the structure and the associated cost of transportation.

The fact that the allocation of space on the Cross Bay Link heavily supports leisure activities is a sign of changing times, Sham suggests. A third of the bridge's width has been given over to a two-way cycle path, planting and a large pedestrian footway with viewing areas. "Twenty years ago, if someone suggested a footway along a bridge of this size, the assumption would be that no one would use it," he says. Also notable is the fact that this space is not secondary to vehicles. Instead, a transparent panel along the full length of the crossing allows users to enjoy views in all directions, without the noise and discomfort of being next to traffic.

WORLD FIRSTS

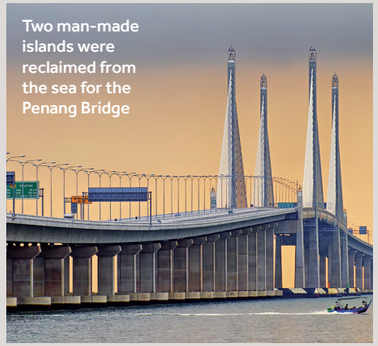
SHAM'S BRIDGE DESIGNS ARE LEADING THE WAY

The design and construction of the Taizhou Bridge in China – the world's first three-tower, two 1,080m-long span suspension bridge, for which Sham was AECOM's project manager and project director – was recognised with top awards from both the Institution of Structural Engineers and the International Association for Bridge & Structural Engineering. Likewise, the 24km-long Second Penang Bridge in Malaysia, on which Sham was heavily involved in the engineering studies, design and construction, scooped the Institution of Civil Engineers' Brunel Medal in 2015.

This year, Sham also hopes to complete another major project, this time in Bangladesh: the 6.15km-long Padma Bridge. He led the conceptual, preliminary and detailed design for this double-deck highway and rail crossing, a long-term project on which his first site visit dates back some 15 years.

The Padma Bridge in Bangladesh is being built using 122m-deep pile foundations

The Taizhou Bridge's cables are monitored in real time via sensors



Two man-made islands were reclaimed from the sea for the Penang Bridge

WDBA/BRIDGING NORTH AMERICA

The Gordie Howe International Bridge will have six lanes for traffic, a cycle lane and a footpath

Sham's workload shows no signs of abating. His new projects include the detailed design of the Gordie Howe International Bridge (left) – the world's longest steel-concrete composite cable-stayed bridge, to be built between Canada and the US – as well as a technical management and contract administration role on the 22km-long Mumbai Trans-Harbour Link (opposite), which is due to be completed in 2023.

He uses the latter project to give an example of some of the recent changes he has seen in the transportation world. "The steel bridges for this project are fabricated in China, Japan, Myanmar and Thailand. Before the pandemic, I would have had to travel there, and it would be half a day in a Land Rover to reach the fabrication yard so I could carry out the inspection. These days, I get up at the crack of dawn to carry out the inspection by video link," he explains. Sham believes that this will become accepted practice even when the pandemic subsides, cutting down on travel time and carbon emissions for transportation professionals operating globally.