SPOTLIGHT

New access to energize Bay Area

The bridge-tunnel link will integrate cities alongside the Pearl River estuary into a dynamic community

Aerial view of the Zhuhai section of the Hong Kong-Zhuhai-Macao Bridge in Zhuhai, Guangdong province, in September. The bridge is a dual three-lane expressway connecting the three cities. LI JIANSHU / FOR CHINA DAILY

From left: A ceremony with fireworks marked the start of construction in 2009; All supports were completed in 2015, and its two sections were joined in 2016.
PHOTOS BY VINCENT CHAN, CHEN LIN, ZHONG FAN FOR CHINA DAILY / XINHUA

By HE SHUSI in Zhuhai, Guangdong
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The 55-kilometer Hong Kong-Zhuhai-Macao Bridge (HZMB), which opened to traffic on Oct 24, will provide a crucial boost to the development of the Guangdong-Hong Kong-Macao Greater Bay Area, analysts said.

As the first road link to span the Pearl River Estuary, the bridge and tunnel will energize the regional economy and integrate cities from both sides of the estuary into one dynamic community.

The Bay Area, in the Pearl River Delta, encompasses nine cities in South China's Guangdong province plus the two special administrative regions (SARs) of Hong Kong and Macao.

Last year, the total GDP of those 11 cities reached 11.7 trillion yuan ($1.69 trillion). That means 5 percent of the nation's population contributed over 14 percent of the country's GDP in 2017.

Like the San Francisco Bay Area in the United States, the strategy behind the development of the Bay Area in China was to merge the 11 cities into a world-class city cluster, able to compete on a global scale.

"The HZMB is one of the most important elements of the development of the Bay Area," said Jason Ni Mengcheng, an assistant professor in the Department of Architecture and Civil Engineering at City University of Hong Kong. Ni specializes in research into large transportation infrastructure.

The bridge, he said, will redistribute resources in the Bay Area and generate a significant impact on regional development.

Noting that the HZMB will be open 24 hours a day, Ni said the structure, for the first time, will provide an unstoppable transportation channel between east and west across the Pearl River Estuary.

Although ferry services run throughout the day, their frequency is reduced substantially after midnight, Ni said. Thus, the operation of the HZMB will significantly increase the flow of people and goods across the estuary.

Ni also noted that the bridge will encourage more Hong Kong people to visit Macao. This will promote communication and exchanges of professional services between the two SARs. He predicted it will help diversify Macao's economy, which is heavily reliant on tourism and the gaming industry.

Construction of the HZMB, the world's longest sea-spanning structure, began at the end of 2009.

The bridge cuts the travel time between Hong Kong and Zhuhai or Macao from four hours by car to less than 60 minutes.

Antony Leung Kam-chung, Hong Kong's financial secretary from 2001 to 2003, participated in the SAR government's initiative to build a bridge connector prior to 2003.

A study of the Pearl River Delta at that time showed that foreign and Hong Kong investors would be most attracted to locales within three hours of Hong Kong, Leung said.

Development still lags in places like Zhuhai and Jiangmen, which are farther away, on the western side of the delta, he continued.

With the opening of the bridge, and with the Guangzhou-Shenzhen-Hong Kong Express Rail Link now operational, he predicted more investment will flow westward as far as the Guangxi Zhuang autonomous region.

Lin Ming, chief engineer of the bridge's island and tunnel project, said the HZMB will create more urban areas in the Bay Area, given that urbanization is stimulated in coastal regions.

"The delta in Guangdong is a perfect site for metropolises," Lin said. "Sustainable development in the delta requires more transportation infrastructure — the more, the better."

The HZMB also will serve as an example for future cross-border cooperation under the "one country, two systems" principle. The project was a cross-border effort, shared by the governments of Guangdong, Hong Kong and Macao.

Su Yi, head of the Working Group on Cross-boundary Policy Research for bridge operator the HZMB Authority, said the cooperation and coordination among the three governments opened a door for institutions under different political systems and cultures to conduct more exchanges.

It has laid a foundation for the three administrations to have more cooperation in the future development of the Bay Area, he said.

Better communication within the Bay Area will start with the easier flow of capital trading and the innovation of policies, Su said. But ultimately, it is about the connection between people from different backgrounds, he said.

Gavan Ord, manager of business and investment policy for CPA Australia, a global accounting body, said that it helps change people's mindsets in terms of business activities with Macao, Zhuhai and other cities on the western coast of the estuary.

"With the opening of the HZMB, you feel that you are closer to the other side of the ocean, and it helps integrate separate communities into one," Ord said.

> **"The HZMB is one of the most important elements of the development of the Bay Area."**
> **JASON NI MENGCHENG**
> Assistant professor in the Department of Architecture and Civil Engineering at City University of Hong Kong

Complex geology spurs technological innovation

Unique solutions set the scene for future marine engineering projects

By HE SHUSI

The complex geology of the Pearl River estuary in South China was a driving force behind the technological innovation that makes the Hong Kong-Zhuhai-Macao Bridge (HZMB) stand out from similar projects around the world, according to civil engineers.

They point to the estuary's variable soil conditions, with thick layers of soft alluvial clay that subject its undersea tunnel section, at a depth of about 50 meters, to high hydraulic pressure, and say the entire 55-kilometer structure may be the most complex and challenging sea crossing ever built — in addition to being the world's longest.

Hans de Wit, managing director of Tunnel Engineering Consultants, a leading tunnel construction company based in the Netherlands, said complicated infrastructure projects like the bridge typically stimulate innovation.

De Wit, who has nearly 30 years of experience in immersed tunnel projects, was the lead consultant for the design and construction of the HZMB's island and tunnel project.

The size of the bridge project and its immense budget allowed for study and innovation, he said. "Additionally, these large infrastructure projects very often contain technical challenges beyond the current state of the art. This is also the case with the HZMB."

The bridge's 6.7-kilometer tunnel, the world's longest immersed tunnel for road traffic and China's first offshore immersed tunnel, was the most technologically challenging part of the project.

The tunnel sits in a 20-meter-deep trench along the seabed, and the soil conditions there determine the stability and solidity of its foundation.

There are 33 sections in the HZMB tunnel, with dozens of joints between each section. Unexpected subsidence of a near 80,000-metric-ton tunnel section due to an unstable foundation could destroy the whole undersea structure.

Unlike similar projects in South Korea and Denmark, where tunnels cross straits with relatively stable geology, the loose sediment of the Pearl River estuary is easily affected by waves and tides, making the seabed unstable.

As a result, the construction team decided to install an extra man-made rock block layer that is 2 meters thick under the tunnel base, in addition to the traditional 1.3-meter gravel bed.

De Wit said the additional rock block will make the tunnel's foundation more uniform and keep subsidence within an acceptable range.

Internationally, settlement of an immersed tunnel needs to be within 20 centimeters. But that of the HZMB has been controlled within 10 cm, according to its chief engineer, Su Quanke.

The frequent typhoons and rainstorms that hit South China in summer add to the challenges of offshore construction, and each day saved reduced risks to the project.

The 55-km bridge-island-tunnel complex withstood a lashing from Typhoon Hato in August 2017, when the project was still under construction, and Typhoon Mangkhut in September of this year. The two typhoons claimed more than 10 lives in China, and caused billions of yuan in economic losses.

"Looking at approximately 14 years of preparation and construction of the project under these challenging conditions, the result is very impressive and will make everybody who contributed to the project very proud," De Wit said.

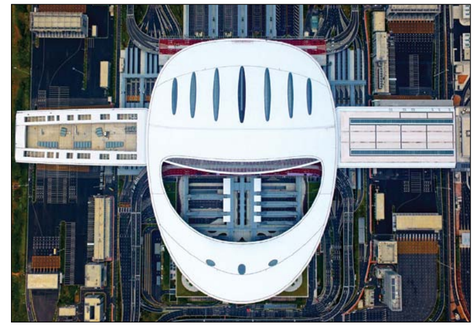
"The HZMB project really stretched the limits of immersed tunneling.

"China has all the potential to become one of the leading countries in immersed tunnel projects."

Peter Lee Kai-kwong, dean of the faculty of science and engineering at Chuhai College of Higher Education in Hong Kong, said the HZMB project has led to the accumulation of valuable experience for similar projects, and presented many innovative solutions to upgrade the world's tunnel engineering technologies.

The Shenzhen-Zhongshan Link being built across the Pearl River estuary is a perfect example. Based on technologies, marine data, talent and other experience from the HZMB, the new link is also a bridge-island-tunnel complex, about 40 km north of the HZMB.

As the estuary's first sea crossing, the HZMB has solved the puzzle of its complex geology, setting the scene for future massive marine engineering projects in the area.



An aerial photo focuses on the Macao entry port of the Hong Kong-Zhuhai-Macao Bridge (HZMB), which opened to traffic on Oct 24. ZHANG JINJIA / XINHUA

One of the two 100,000-square-meter artificial islands of the bridge under the setting sun. PROVIDED TO CHINA DAILY