Shenzhen-Zhongshan Undersea Immersed Tunnel

1 Project overview
Shen-Zhong Channel (Shenzhen-Zhongshan Channel) is connecting Shenzhen and Zhongshan, China. It has many characteristics such as a cluster project of super-wide-and-long subsea immersed tunnel, super-large sea-crossing bridge, artificial island in deep water and underwater interworking, first steel-shell immersed tunnel in China, and most complex and difficult project in terms of construction standard, project scale and construction technology. The channel starts from Guangzhou-Shenzhen High-speed Airport Viaduct, connects Shenzhen, crosses Pearl River Estuary and Ma’an Island in Zhongshan, and ends on Hengmen Interworking. It has a total length of 24 km. The gap between Zhongshan and Shenzhen, Guangdong, Hong Kong and Macao can be narrowed after the completion of the channel, and the traffic for industrial transfer of Guangdong-Hong Kong-Macao Great Bay Area can be improved and connected.

2 Project challenges
(1) The 8-lane highway standards are adopted; the maximum width of the immersed tunnel reaches 46-55.5 m and the span of single hole reaches 18.3-24.0 m, which are the tops around the world.
(2) The immersed tunnel is with deep burial depth, high water pressure and various geological conditions. The elements E1 to E5 are located in sanding area with complex and sensitive geology. The rational selection of tunnel foundation consolidation method is the key.
(3) The width of open-cut and cast-in-situ tunnel on main line of east island reaches 46.0-69.8 m. The Airport Viaduct adopts subsea interchange viaduct ramp tunnel with minimum diameter of 125 m and maximum longitudinal slop of 3.78%. The mainline tunnel crosses underneath highway piers along the river, and the ramp tunnel partially crosses underneath and adjacent to highway piers. The minimum distance between tunnel structure and existing pier is 2 m, whose design and
construction is a challenge for Shen-Zhong Channel.

(4) The main span of Lingding Channel Bridge is 1,666 m, the bridge is 10 km away from Zhongshan coast, the clear span for traffic of the bridge is 76.5 m, and the designed wind speed is 53.7 m/s. The designs of wind resistance of suspension bridge and large undersea anchorage of Lingding Channel are the keys to the bridge project.

3 Project innovations

(1) The steel-shell concrete element structure for immersed tunnel is proposed, and the design and construction technologies for steel-shell concrete immersed tunnel are obtained.

(2) The preparing, casting and quality checking technologies for self-compacting concrete with high strength are developed, and *The Key Technology for Preparing and Construction of Self-compacting Concrete of Steel-shell Immersed Tunnel of Shen-Zhong Channel* is obtained.

(3) The DCM technology is firstly applied to tunnel foundation construction in China, and the design and construction technologies for DCM used in immersed tunnel are obtained.

(4) The idea of integration of element floating and installation is proposed, and equipments for integration of element floating and installation are developed.

(5) The selection of subsea interchange, route standards, adjacent construction of retaining structure of subsea interchange, and design and construction of large cofferdam and super-deep-and-wide foundation pit retaining structure have been solved.

(6) The stability design of wind resistance of super-large span box girder suspension bridge is developed.

(7) The sand-filled land area by locked steel pipe pile cofferdam is firstly proposed, and a 8-shaped anchorage foundation scheme for underground diaphragm on land area is obtained.

4 Project schedule

The west artificial island of Shen-Zhong Channel started on 30th Dec., 2016, the bridge project started in the end of 2017, and the east artificial island started in 19th April, 2018. It would be completed and open to traffic in 2024.