

Young Engineer Workshop 2016

Smart System Design Competition

Using Hong Kong-Zhuhai-Macau Bridge, Guangzhou, China

—Seeking Intelligent Solutions



Organized by

Young Engineer Program of IABSE
Chinese Group of IABSE

1 Background

The Hong Kong–Zhuhai–Macau Bridge (HZMB) is a project which consists of a series of bridges and tunnels crossing the Lingdingyang channel that will connect Hong Kong, Macau and Zhuhai, three major cities on the Pearl River Delta in China. Many shipping lanes is available in these waters and about 4000 ships will travel along the lanes every day, which result in high density of ships in the areas. In addition to complex navigation condition, the project have to suffer from bad environments such as large swells, strong winds, frequent typhoons and strong corrosiveness of marine environment, as a result, the high requests for durability of the project are needed.

The whole link, which measures some 50 km in length, and the Main Bridge section has a length of 29.6km and includes a 6.7 km immersed tunnel that is flanked by 2 artificial islands to accommodate the transition to the bridge part that run towards Hong Kong and Macau / Zhuhai. From Zhuhai–Macau side to west artificial island, the projects in turn are Jiuzhou Channel Bridge, Non-navigable Bridges in Shallow Water Areas, Jianghai Channel Bridge, Non-navigable Bridges in Deep Water Areas, Qingzhou Channel Bridge, Gas Field Pipeline Bridge across the Cliff 13-1, etc. The Link will carry a three-lane dual carriageway with a design speed of 100 km/h and is designed for a 120-year design life. To accommodate the passing of 300,000 tonnes vessels, the tunnel will be approximately 40 m below the sea level.



Fig. 1 General layout of HZMB

1. Cable Stayed Bridge

Jiuzhou Channel Bridge is a steel-concrete composite girder cable-stayed bridge with double pylons and single cable plane. The span arrangement of the bridge is 85m+127.5m+268m+127.5m+85m. The two “sailing”-shaped pylons are 120m high. Jiuzhou Channel Bridge boasts of the largest work amount, the most complex structure and the most critical status among the three cable-stayed bridges of the HZMB project. After completion, the channel bridge will become a window to display the overwhelming splendor of HZMB.



Fig. 2 Jiuzhou Channel Bridge

2. Continuous Bridge

The superstructure of non-navigable bridges in deep water areas are continuous steel box-girder systems with the span of 110m. The bridges contain 124 spans in total and a unit is composed of 6 spans. The width and height of box-girder is 33.1m and 4.5m respectively. Several technical measures such as thickening top plate, strengthening related structure and adding three transverse ribs between two diaphragms are adopted to avoid the problems of pavement and weld joint fatigue in orthotropic steel plate.



Fig. 3 Non-navigable Bridges in Deep Water Areas

3. Tunnel

With a length of of 6.7 km, the immersed tunnel will become the longest in the world. The transition from a link bridge to the tunnel will be realized by two offshore artificial islands. The length of immersed tunnel is approximately 5.7km, and the length of two artificial island are both 625m.

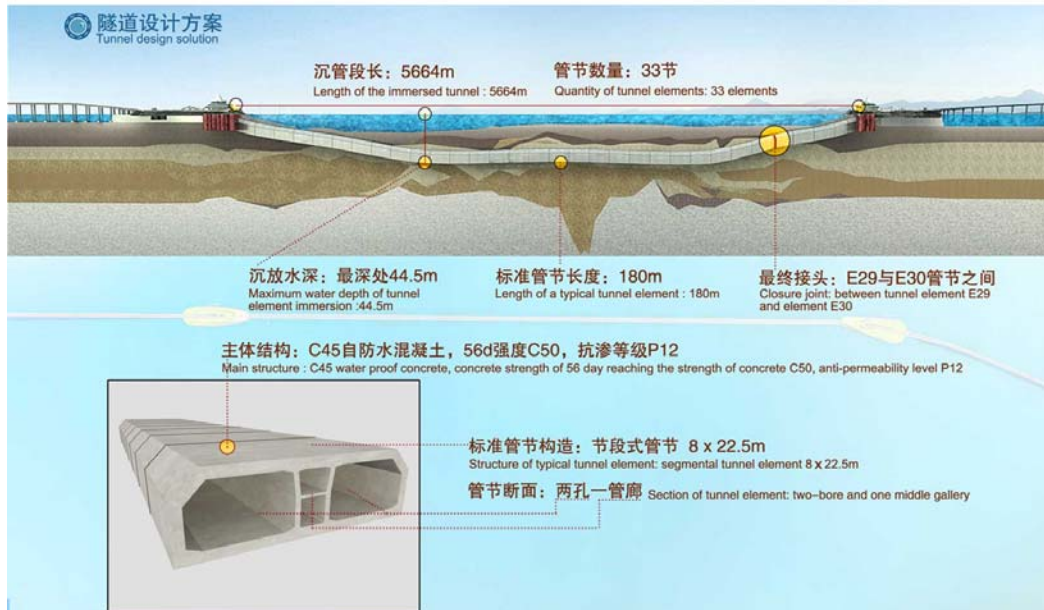


Fig. 4 Cross-section of Tunnel

More details can be found in the supplemental material package.

Structure 1: Jiuzhou Channel Bridge. (pdf & dwg)

Structure 2: Non-navigation Bridge in Deep Water Zone (pdf)

Structure 3: Standard Section of Immersed Tunnel (pdf)

2 Problem

A smart system is to be designed in teams for Hong Kong-Zhuhai-Macao Project, which is a combination of bridges, a tunnel and artificial Islands crossing the Pearl River Estuary and linking Hong Kong to the East, and Zhuhai and Macao to the West. The teams will range from 1 to 5 young participants. The names of the components must be sent to the organizing committee before the deadline presented in the Programme.

Each team is challenged to design a system of sensors to monitor adequately the different structures of the Hong-Kong-Zhuhai-Macao Project. The proposal of an active control system will also be considered positively.

Each proposal should include the parameters to be measured, type and sensor location. Each team will be tutored in a Workshop prior the IABSE Guanzhou Conference, where expert engineers will guide them throughout the design process. The students are advised to bring a studied proposal to the workshop. The students will be provided with complimentary coffee and soft drinks during this event.

After the comments of the tutors, each group will have 24 hours to correct their initial proposal. During this period, each team will be provided with an adequate working space at the conference venue. Each proposal will be presented on a single A2 size board. The best of these boards will be displayed during the last day of the Conference. The awards ceremony will be held during the closing ceremony.

3 Programme

- **10th April 2016 Deadline of the enrolling period.** Prior to this date, the teams willing to participate in the event are required to send their names to iabse2016guangzhou@tongji.edu.cn. Each team will range from 1 to 5 young engineers or students. The maximum age to participate is 35 years. Once reviewed the application each team will receive a team identification number. Any question about the competition can be also sent to the same address.
- **1st May 2016 Proposal submission.** The teams shall submit their proposal in A2 sized pdf with original files to contact.
- **8th May 2016 Young Engineer Workshop.** Each team will present their work and be tutored by experts in monitoring of structures for 3 hours. The participants are advised to elaborate an initial proposal to this workshop.
- **9th May 2016 Proposal submission.** The teams will send their A2 size board in pdf and other original files if necessary.
- **10th May 2016 Shortlisted entries notified.** Selected proposals will be displayed at the conference venue.
- **10th May 2016 Awarding ceremony at the IABSE Conference.** A group of experts will select the awardees. This will occur during during the closing ceremony.

Judging Criteria

The submissions will be judged by a jury of engineers on the basis of the following criteria:

- Innovation
- Engineering concept in combination with advanced technologies
- Adequacy of the smart monitoring system
- Budget and practicability

While the solution should aim to satisfy the brief, a more elegant solution may be admissible even if it is outside the formal requirements. Depending on the number of submissions received, the jury may decide to shortlist 10 (or more) posters to be presented at the conference.

Submission

Submissions are to consist of a single A2 size board, submitted in pdf format by email to iabse2016guangzhou@tongji.edu.cn. Boards should include the team's identification number clearly

located in one corner. No other identifying marks (e.g. entrant names, company/organisation names or logos) should be displayed on the boards. The organising committee will arrange for the shortlisted schemes to be printed. These boards will be displayed for public viewing throughout the conference.

Prize:

Outstanding Design Award (1st Prize X1), Certificate+1000 CHY

Excellent Design Award (2nd Prize X1), Certificate+500 CHY

Exceptional Design Award (3rd PrizeX3), Certificate+300 CHY