HZMB-link project
Hong Kong Zhuhai Macau Bridge link

Hans de Wit & Dirk Jan Peters
Tunnel Engineering Consultants
NL
• HZMB link project summary
• Elements of the work
• Role of TEC
• Transition islands
• Immersed tunnel
Project components
HZMB link project characteristics

- Offshore part 30 km long
- Total investment 38 bn. RMB (app. € 4.5-5 bn.)

- Tunnel + islands app. 6.6 km
- 14 bn. RMB (app. € 1.75-2.1 bn.)

- Start construction: December 2010
- Official opening: October 2018
The larger project

- Pearl River Delta
- Improvement of economic and social integration between East and West shores
- Connection to main road network Guangzhou and Shenzhen
- Total length 50 km
- Investment approx. € 18 bn
The larger project
Zhuhai Link Road

- Tunnel underneath Gongbei border crossing
- Double Deck
- 3m diameter tubes / freezing
Artificial island Zhuhai/Macau

- 500ha
- For access and border control procedures
Hong Kong Link Road

- Main link 30 km
Arificial island Hong Kong
Tuen Mun Chek Lap Kok tunnel link

- 5 km length
- Twin bored tunnel 17.6m diameter
- Land reclamation 16 ha
Main bridge link

- 25 km length
- Cable stayed over secondary shipping lanes
- Connecting bridges (span 110/75 m)
Tunnel underneath main shipping lane transition islands
Project organisation

– **Client: HZMB Authority, consisting of:**
  - Ministry of Communication China ("Public Works")
  - Guandong Province
  - Government of Hongkong
  - Government of Macao

– **Client consultant**
  - Lead consultant / Bridges: SMEDI (China)
  - Tunnels / Artificial Islands: TEC (The Netherlands)
  - Bridges: TY Lin (USA)
  - Tunnels (local input): GMDI (China)

Task of Client consultant:
Design Review / Tender documents / Independent Parallel Analyses
Project organisation

– **Designer**:
  - General / Lead designer        HPDI (China)
  - Bridges                        HPDI / Arup
  - Immersed tunnel                HPDI / COWI;
  - C&C tunnel / Approaches        STEDI (China);
  - M&E                            HPDI
  - Artificial islands             1st / 4th Harbor DI (China)

– **Contractor**:
  - General / Lead contractor      CCCC (China)
TEC company profile

• Permanent joint venture of:
  
  [Logos of Royal HaskoningDHV and Witteveen+Bos]

• Started with immersed tunneling Dutch river crossings
• Later specialized in soft soil bored tunneling
• Involved in 80% of the immersed tunnel projects worldwide (since 1990’s)
• Presently active in submerged floating tunnel research and design
Amsterdam new underground metro line
Various immersed tunnel projects
Hong Kong Zhuhai Macau Bridge China

Transition islands
Artificial islands and cut&cover tunnels

- Main dimensions
  - Tunnel + approaches: 163m(C&C)+382m(Open)
  - Length islands: app. 625 m
Island concepts

- Construction time (related to immersion)
- Weak soils on seadbed
Island concept design
Assembly at steel factory in Shanghai
Transport steel tubes

- Diameter 20 m, heigth 40 m
- Transport per ship from Shanghai
Arrival on site
Installation of tubes

• Installed in sea bed using 8 coupled vibration blocks
Filling of tubes and installation of connection elements
Tubes installed
ground improvement around island
Filling of the island and excavation of receiving pit
Piled foundation of cut & cover tunnel
Cut & Cover tunnel under construction
Cut & Cover tunnel under construction
Structural section for connection with first tunnel element
After removal of steel tube wall
East island and Cut & Cover tunnel under construction
East island nearing completion including control & operations building
Hong Kong Zhuhai Macau Bridge China

Immersed tunnel
Immersed Tunnel

- Tunnel length 6.8 km
- 2 x 3 lanes (38 x 11.4m)
- Immersed part 5.7km
- 33 elements (180/110/90 m) – 75,000 tons
- Tunnel roof 30 m under sea level
- Future deepening of channel for 300,000 tons ships (until then 20 m ground cover)
Construction sequence (concreting afloat)

1.) Casting basin
2.) Steel box assemblage
3.) Transport
4.) High fluidity concrete placing works
3. Full Sandwich
(Replace all rebar by steel shell)

- Naha port tunnel, Japan
Traditional construction method

• Concrete tunnel elements
• Constructed in temporary dock / polder
Construction site tunnel elements

- Guishan Island at approx. 10 km from project location
- Factory based construction method
‘Modern’ element production facility

- First applied for Oresund link (Sweden-Denmark)
- Picture HZMB facility

1. Assembly reinforcement cage
2. Casting
3. Concrete factory
4. Stock
5. Undeep part basin
6. Deep part basin
7. Floating dock gate
8. Sliding door
9. Supply materials
Overview production facility
Factory hall under construction (formwork in foreground)
Assembly of reinforcement cage – phase 1
Sliding of reinforcement cage to phase 2
Assembly of reinforcement cage – phase 2
Assembly of reinforcement cage – phase 3
Full section casting

- After sliding reinforcement cage to casting location and after installation of formwork
Removal of formwork
Tunnel pushed to undeeep basin
Dock flooded to move elements to deep part
Tunnel elements in deep part of basin
Fitting out for transport to construction site
Towing out of tunnel element
Transport of tunnel element
Positioning of tunnel element
Immersion operation
Closure Joint

- Located between E29 and E30
- Prefabricated and installed in one piece
- Steel shell- concrete combined structure
- Approx. 6,100 tons
- Hoisted and installed with specialized vessel
Steel shell-concrete combined closure joint
Hoisted and installed by 12,000 ton capacity all direction rotation floating crane vessel
Closure joint installation
Fitting out of the tunnel
Summary of project achievements

- Chinese – European cooperation and knowledge building / exchange
- Island construction incl. wall
- Variety of soil improvement and foundation techniques
- Huge differences in tunnel soil coverage and semi rigid section couplings
Thank you for your attention