Immersed Tunnels
Recent developments

Kelprojektas seminar –
Transport Infrastructure Innovations

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Content

- General introduction Royal HaskoningDHV
- Principles immersed tunnels
- Main benefits
- Recent innovations
Profile

- Global consultancy, design, engineering and project management service provider
- Leader in sustainability and innovation
- Top 10 of independently owned, non-listed companies
- Top 40 worldwide
- Turnover in excess of €650 million
- Nearly 7,000 experienced and diverse team members
- Leading professionals in our fields
Our markets

- Aviation
- Maritime & Waterways
- Transport & Asset Management
- Infrastructure
- Planning & Strategy
- Water Technology
- Rivers, Deltas & Coasts
- Industry, Energy & Mining
- Buildings
Basic principle Immersed tunnels
Production tunnel elements
Busan Geoje IMT, South Korea
Transport

- Wave conditions
- Limitations in transport route
  - Water depth
  - Locks
- Limitations at project site
Principle of immersion
Principle immersed tunnels
Principle of joining / Gina gasket
Principle of joining
Immersed tunnel Busan-Geoje South Korea
Video Strukton Immersion Projects
Potential advantages in alignment design - especially river crossings
High bridges with long approaches?
Bored tunnel – deep level, long approaches
Practically every shape

→ rectangular, circular etc
→ cost effective for wide tunnels
Cost effective for wide tunnels
(multiple road lanes or combined road – rail tunnels)

→ example multiple traffic lay out
Practically every waterway
Characteristics / Advantages

- Suitable for various and relatively poor soil conditions
- Parallel construction processes
- Relatively low and manageable risk profile
- Capable of dealing with (severe) seismic events
- 80-90% of all design and construction works can be done by local companies (limited input from international specialists)
Disadvantages / Prejudices?

- Environmental impact of dredging
  - Contaminated soils
  - But also opportunities? → Land reclamations
- Construction impact on shipping
  - Limited and manageable impact
  - In practice often an issue that can be addressed properly by good communication
Innovations

1. Caland tunnel, The Netherlands
2. Øresund Link, Denmark
3. Busan Geoje, South Korea
4. HZMB, China
5. Fehmernbelt Link, Denmark
Caland tunnel – The Netherlands
Extension immersed section
Caland tunnel – The Netherlands
Extension immersed section
Øresund Link, Denmark
Traditional production tunnel elements
Øresund Link, Denmark – new developments

Factory Production / Full Section Casting
Production Factory Principle
Øresund Link, Denmark

Dredging & Environmental issues
Busan Geoje Fixed Link, South Korea
Busan Geoje Fixed Link, Challenges

• Deep level
• Poor soil conditions

• Adverse marine conditions (off shore)
• Seismic events and exceptional wave conditions due to typhoons
Busan Geoje Fixed Link, South Korea

Full section casting in traditional casting basin
Busan Geoje Fixed Link, South Korea

Soil treatment of poor soils
Busan Geoje Fixed Link, South Korea

Special equipment for transport and immersion
Hongkong Zhuhai Macao Link, China
Hongkong Zhuhai Macao Link, Challenges

- Geotechnical conditions
- Depth
- Geometrical (span + length)
- Off shore conditions
- Design life of 150 years
Hongkong Zhuhai Macao Link, Challenges

- Controlled conditions for element production
Hong Kong-Zhuhai-Macao Link China
Hongkong Zhuhai Macao Link, Challenges

- Ground conditions
Hongkong Zhuhai Macao Link, Challenges

- Offshore conditions
FehmernBelt Link, Denmark
FehmernBelt Link, Denmark

Special elements for M&E and maintenance
FehmernBelt Link, Denmark

Construction

4 x times Oresund
FehmernBelt Link, Denmark

Environmental – re use of dredged material
FehmernBelt Link, Denmark

Safety Concept ventilation

Safety Strategy based on three levels:

• Level 1 – prevention of accidents and fires through design and operation
• Level 2 – control of incidents, and self-rescue
• Level 3 – facilities for emergency services response and rescue
FehmernBelt Link, Denmark

Longitudinal ventilation for operation and fire
FehmernBelt Link, Denmark -- Video
Ačiū už dėmesį

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