

Contract BC1

Railway Bosphorus Tube Crossing Tunnels and Stations (Marmaray)

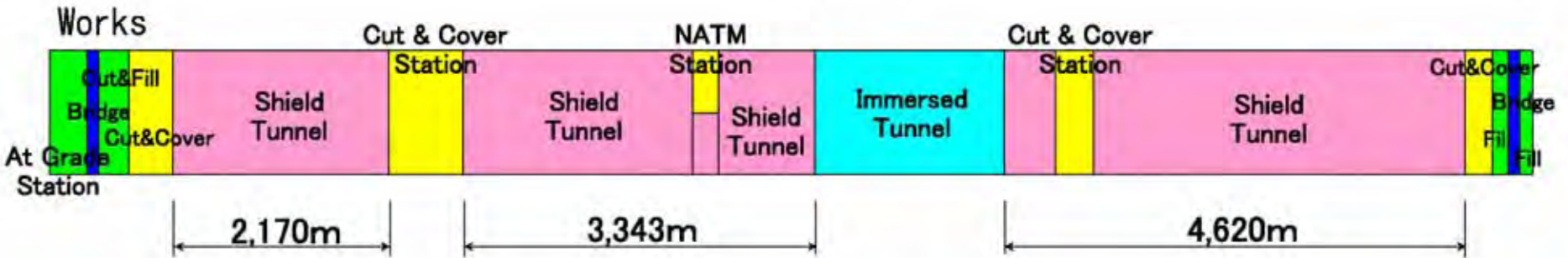
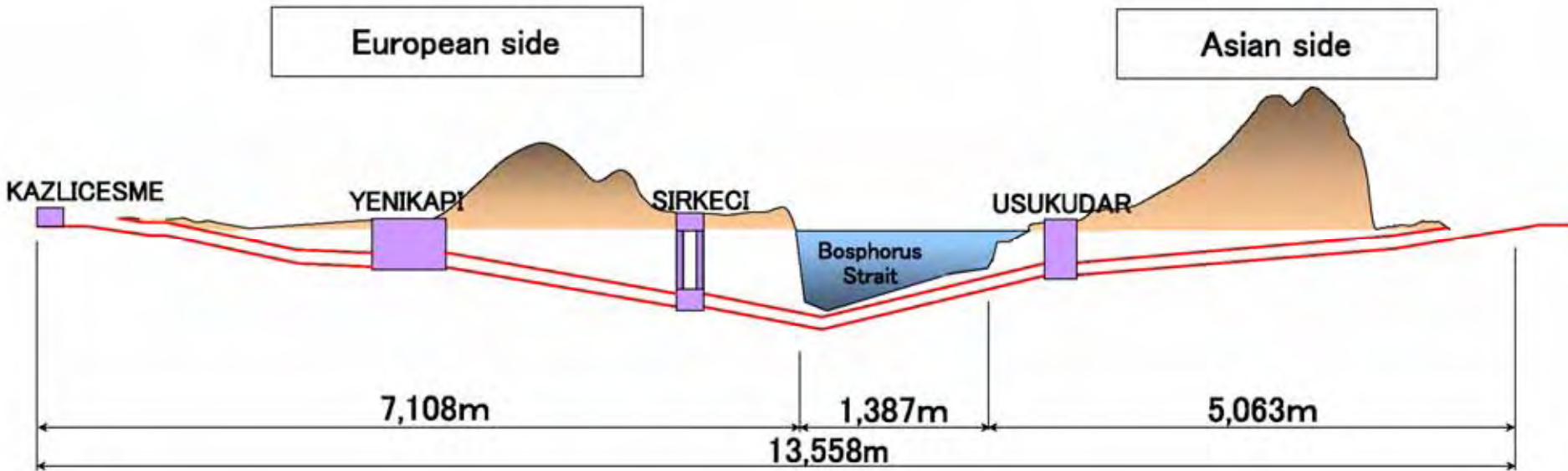
Bosphorus Strait



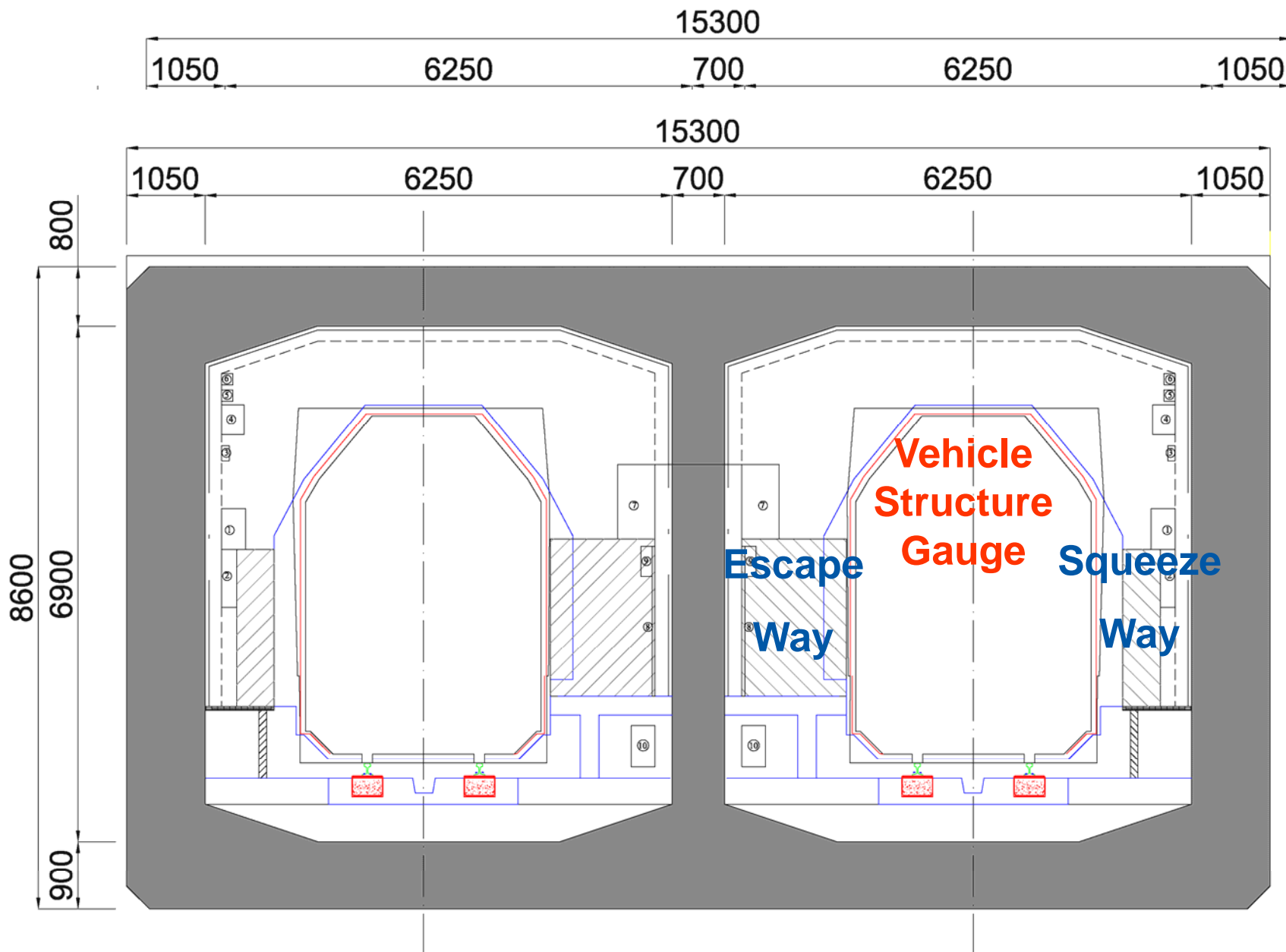
Project Location



Longitudinal Section



- Design Basis Earthquake : Mw = 7.5
- Countermeasure to Liquefaction
- Huge Water Pressure : Max. 60m
- Rapid Current
 - Upper Layer (N to S) : Max. 5 knots
(2.5m/sec)
 - Bottom Layer (S to N) : 1 ~ 1.5 knots
- Fire Resistance : 100 Mw Fire
Train with Petrol Fire



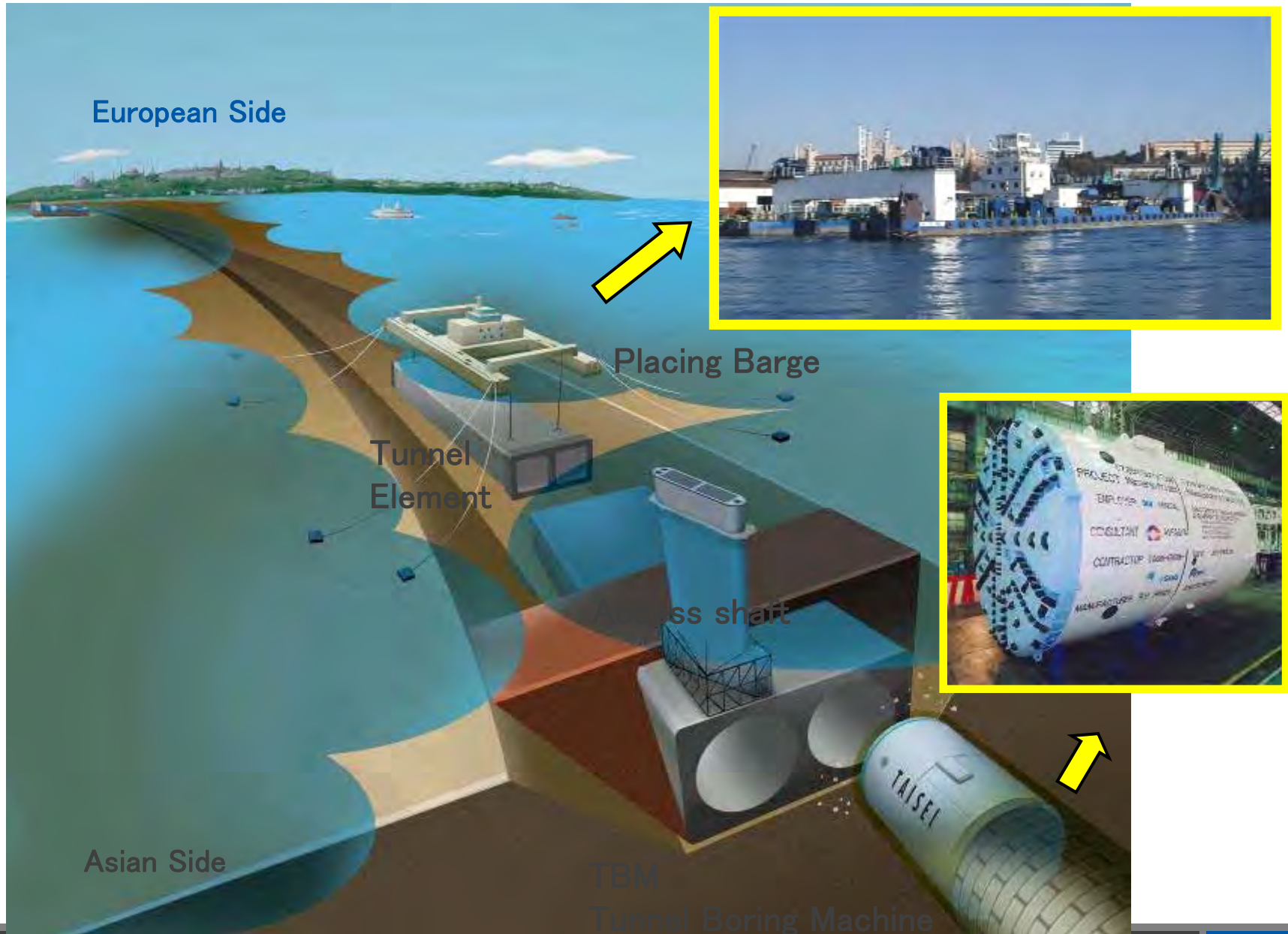


IMMERSE TUNNEL Construction

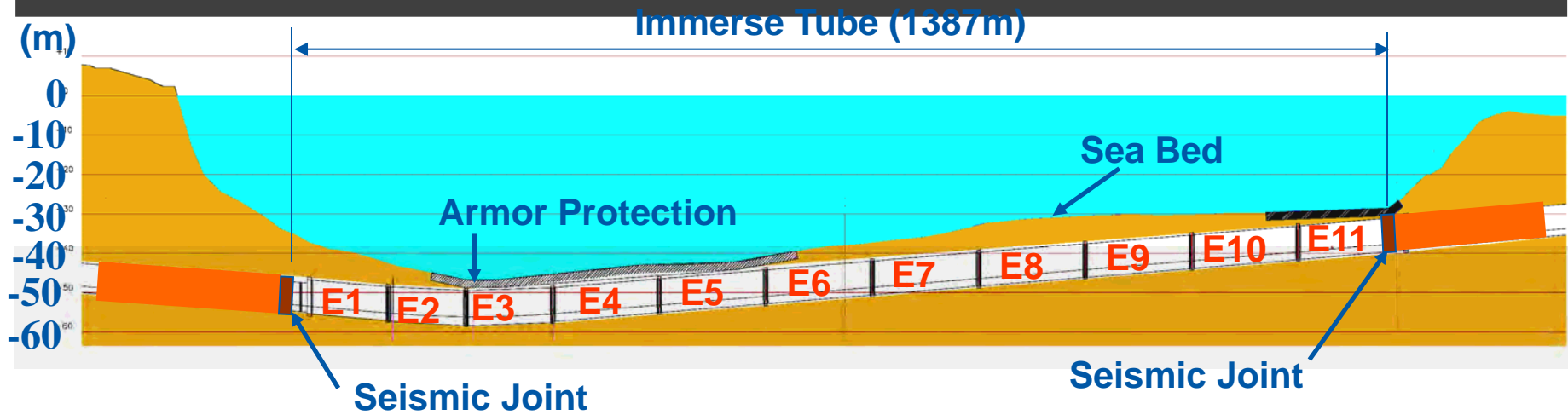
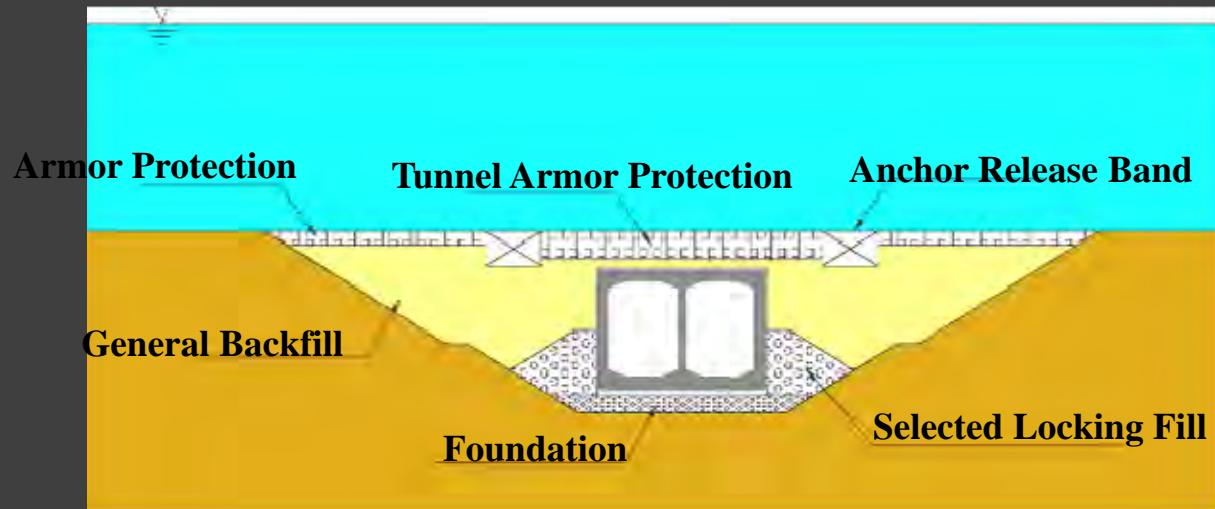
Bird View Istanbul Strait Crossing



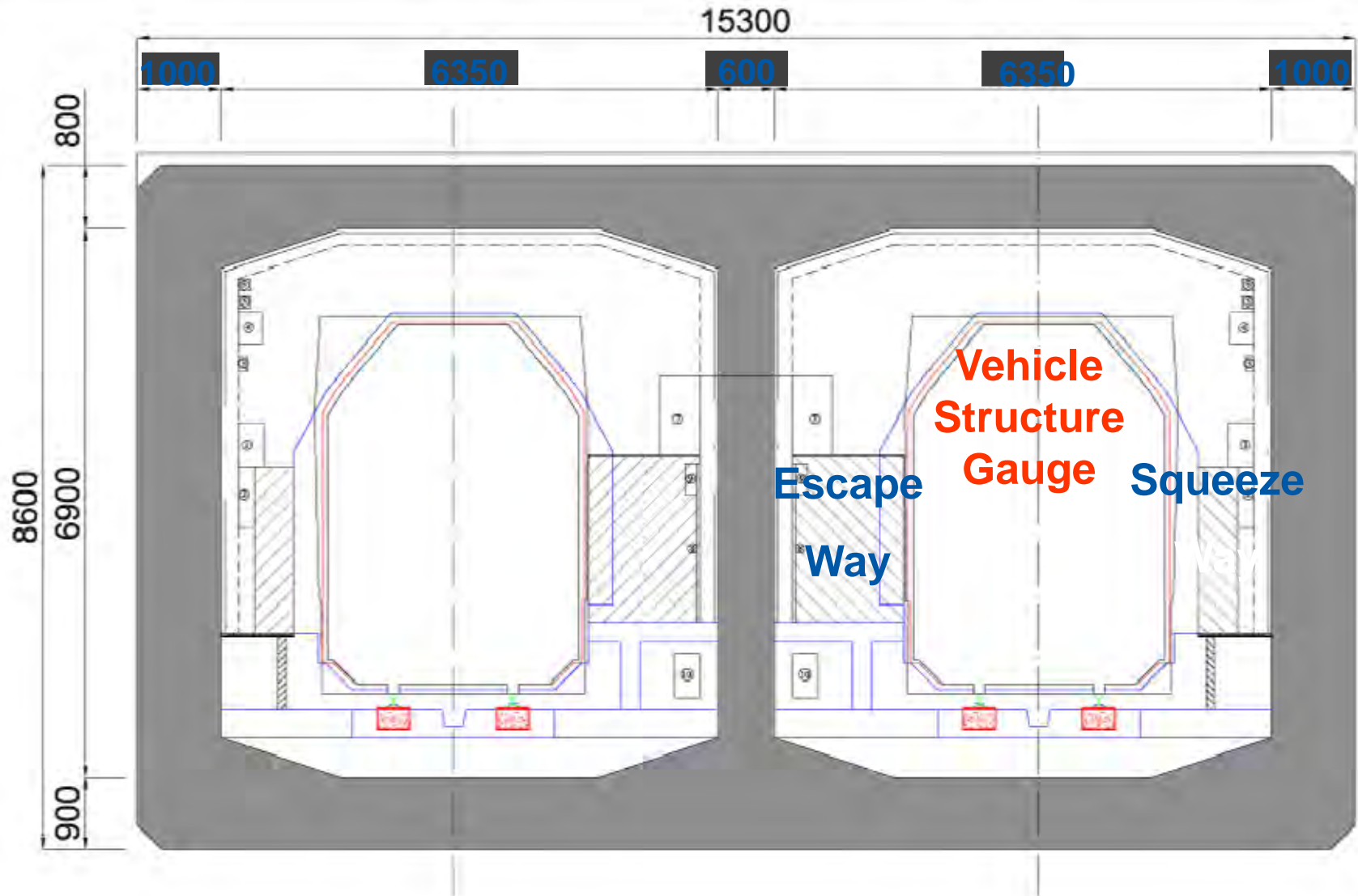
Immersion Procedure



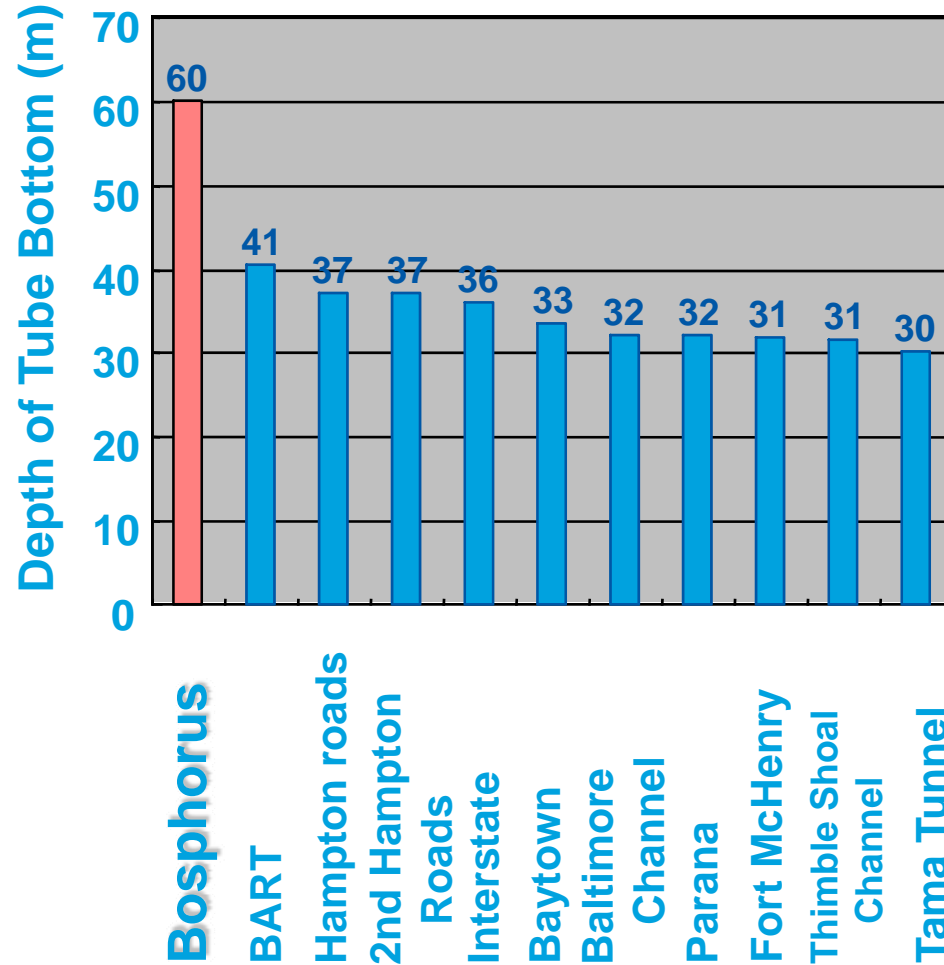
Tunnel Cross and Longitudinal Section



Typical Cross Section of Immersed Tunnel Element



Comparison Major Tube in the World

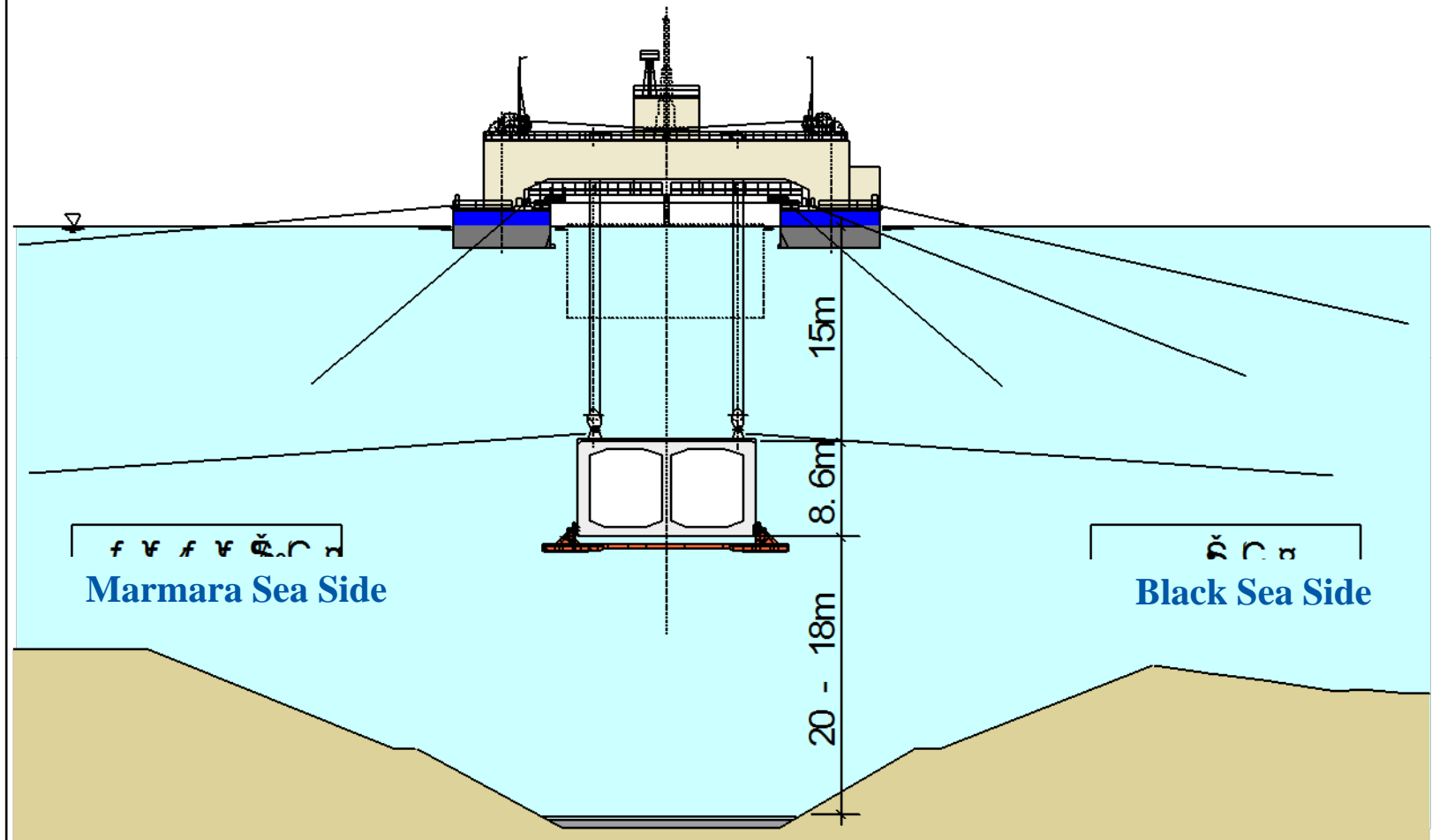


Tuzla Dry Dock TUBE Fabrication



Immersion Procedure

Before Immersion (Anchoring Completion)

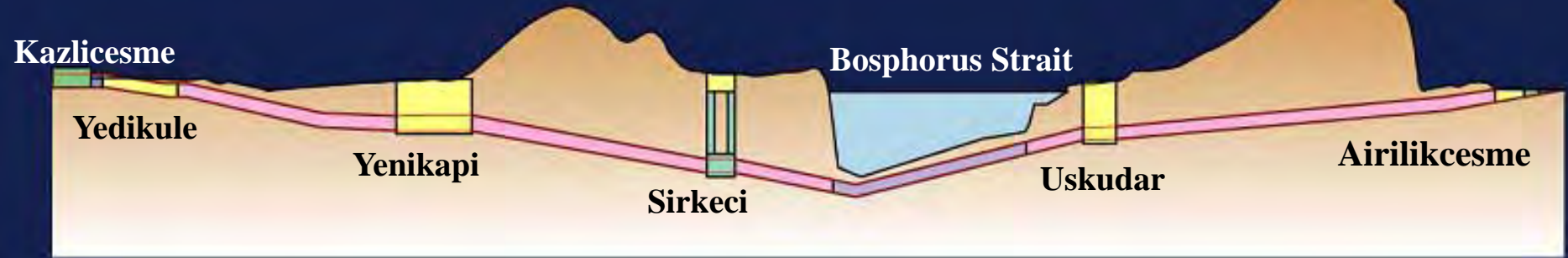




Slurry Type TBM TUNNEL Construction

European Side

Asian Side



2170m

3343m

4620m



TBM (Slurry Type) $\phi=7,640\text{mm}$ 、 $L=11,000\text{mm}$



Tunnel Inside (Asian Side – Sept.07)

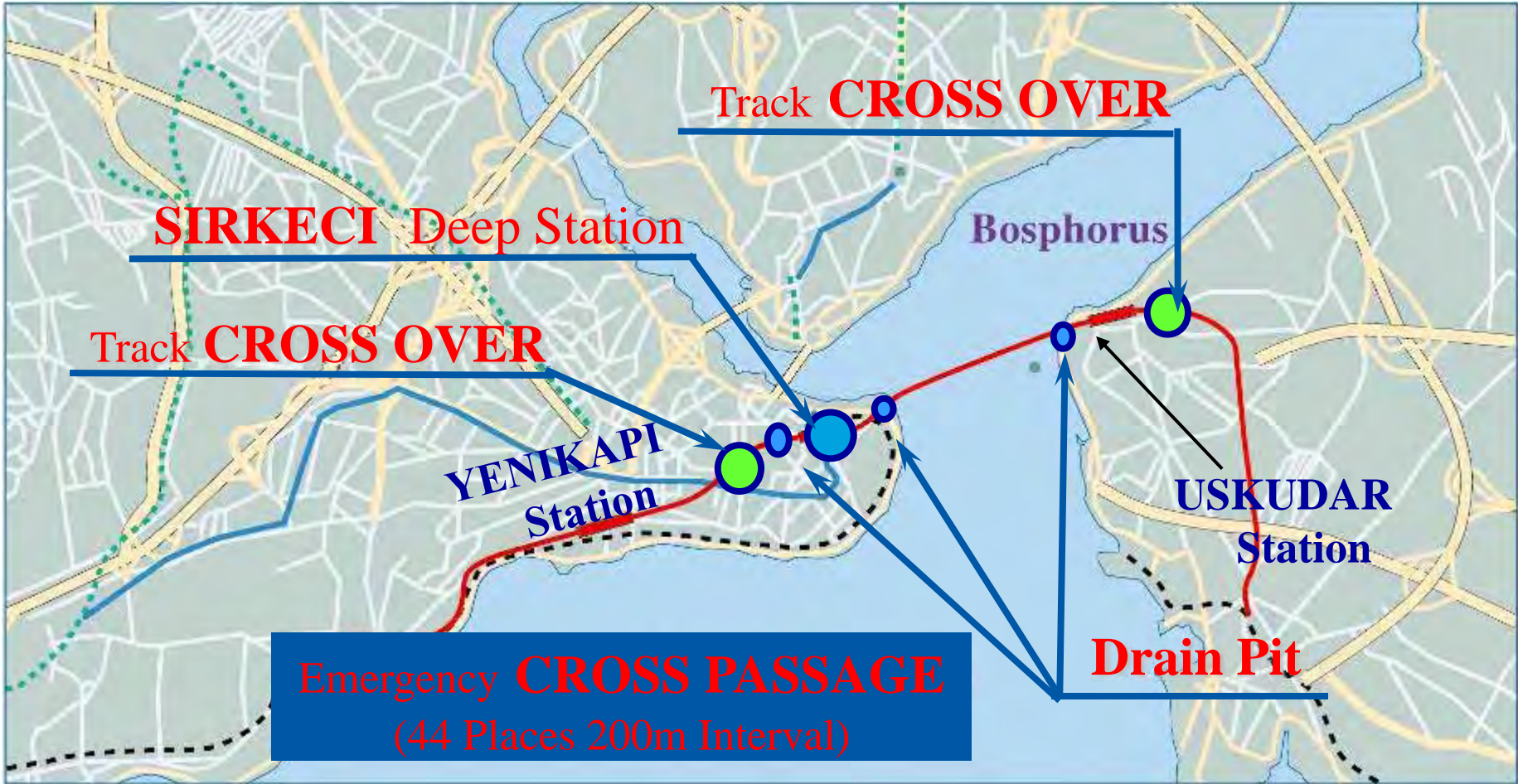


Tunnel Inside (Asian Side – Uskudar Station Breakthrough – July 09)

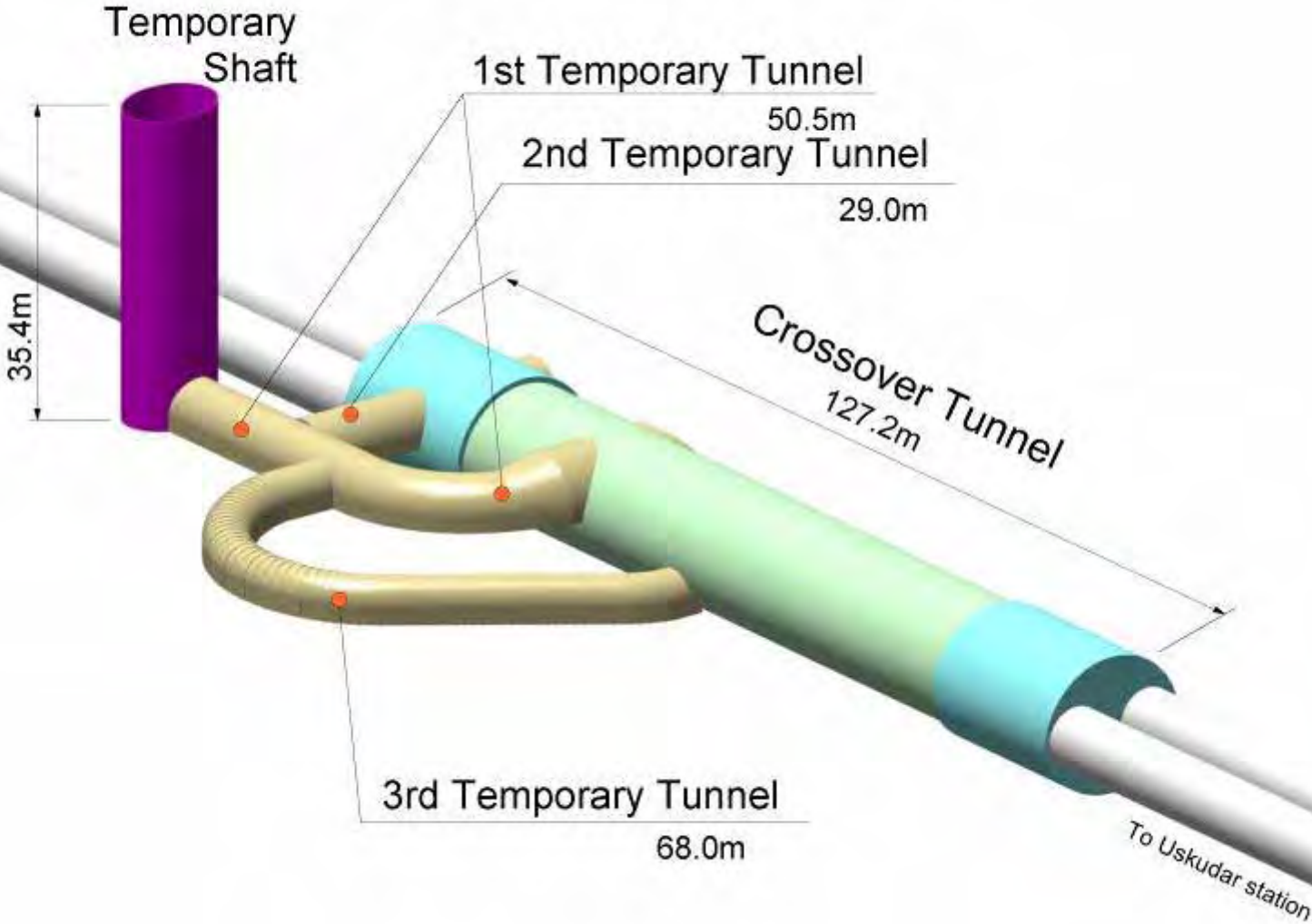




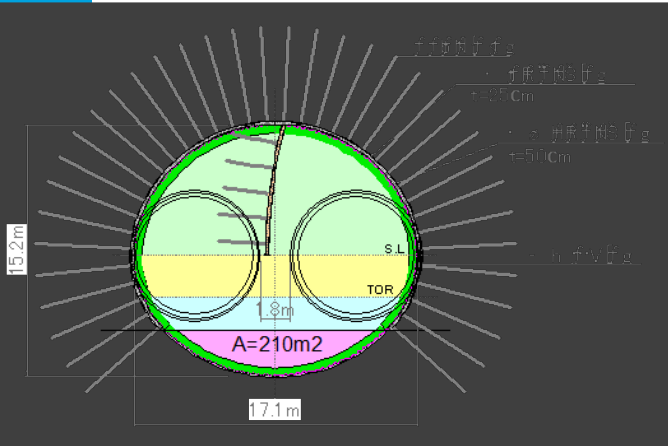
NATM TUNNEL Construction



Uskudar Cross Over Tunnel Model



Uskudar Cross Over Tunnel Excavation



Lining Concrete



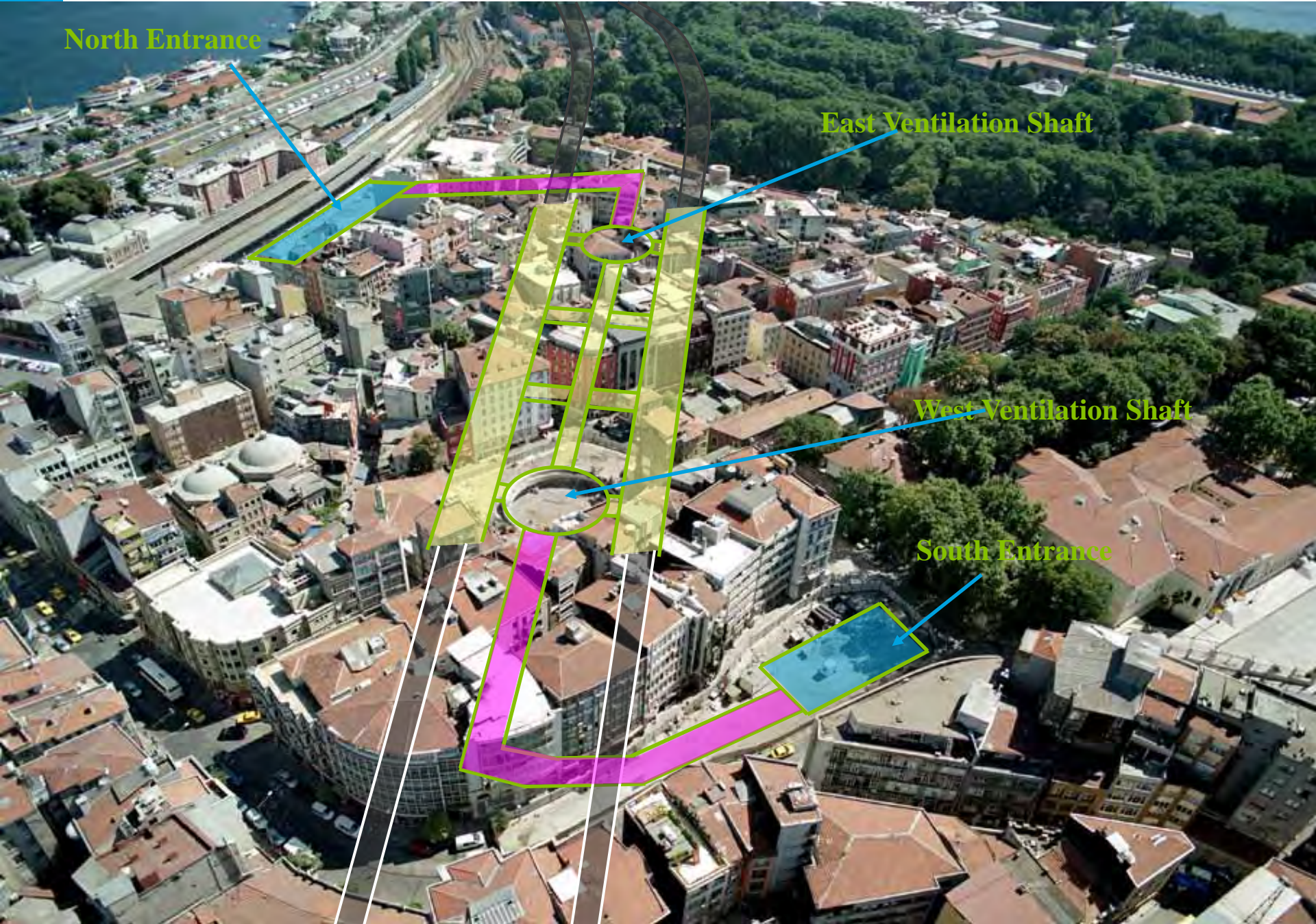
Bird View around Sirkeci Station

North Entrance

East Ventilation Shaft

West Ventilation Shaft

South Entrance



Sirkeci Station NATM Works



Bird View of Uskudar Station Area



Immersed Tunnel

Uskudar Sta.

Station Excavation



U/W Concerns

- Project of almost prototypical nature – deepest ever submerged
- “atypical” connection sea-land tunnels
- Strong bi-directional current in the Bosphorus straight
- Heavy ship traffic with “reckless” ship owners at times
- Due to deep tunnels high water pressure and hence water tightness issues
- An overseas contractor moving in unknown cultural environment
- Land tunneling under densely built up (historic) areas